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THE
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BENJAMIN SILLIMAN,

PROFESSOR OF CHEMISTRY, MINERALOGY, ETC. IN YALE COLLEGE; CORRESPONDING MEMBER OF THE SOCIETY OF ARTS, MANUFACTURES AND COMMERCE OF LONDON, MEMBER OF THE ROYAL MINERALOGICAL SOCIETY OF DRESDEN, AND OF VARIOUS LITERARY AND SCIENTIFIC SOCIETIES IN AMERICA.

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PREFACE.

A TRIAL of four years has decided the point, that the American Public will support this Journal. Its pecuniary patronage is now such, that although not a lucrative, it is no longer a hazardous enterprise. It is now also decided, that the intellectual resources of the country are sufficient to afford an unfailing supply of valuable original communications, and that nothing but perseverance and effort are necessary to give perpetuity to the undertaking.—The decided and uniform expression of public favour which the Journal has received both at home and abroad, affords the Editor such encouragement, that he cannot hesitate to persevere—and he now renews the expression of his thanks to the friends and correspondents of the work, both in Europe and the United States, requesting at the same time a continuance of their friendly influence and efforts.

YALE COLLEGE, Sept. 25, 1822.

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Mr. Barnes on the Canaan Mountain.

Page, 11, 3d line from bottom, for *squamosa*, read *squarrosa*.

" 15, line 10 from bottom for *nunken*, read *sunk*.

" 7, between "part" and "of" read (an omitted clause) of the
same range and.

In the explanation of the plate, line 8 from bottom, for *Jones'* read *Janes*.

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THE
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GEOLOGY, MINERALOGY, TOPOGRAPHY, &c.

ART. I.—*A memoir on the natural Walls, or solid dykes, in the State of North-Carolina; about which there have been debates, whether they were basaltic, or of some other formation; by JOHN BECKWITH, M. D. fellow of the College of physicians in New-York, &c. to Samuel Mitchell, M. D. & P. &c. dated Salisbury, North Carolina, December 18, 1821.*

[Communicated for this Journal.]

Dear Sir,

I RECEIVED your letter of the 3rd of Oct. and have, agreeably to your request, put up a set of the specimens taken from the different basaltic walls in this neighbourhood, illustrative of their formation. You will probably receive them shortly by one of the coasting vessels from Wilmington to New-York. You also expressed a wish that I would communicate such information, connected with their history as might be in my possession; and referred me to several Vols. of the Medical Repository, for what had been written upon the subject. I had read and compared the descriptions given by the Rev. Dr. Hall, and the Rev. Zach. Lewis, with the walls themselves, and found them in many particulars correct; and I cannot perhaps better convey my own views than by quoting occasionally from them. I shall not however attempt to discuss with these gentlemen, the question of their origin or nature: it is a matter so completely

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within your province, and with which you are so thoroughly acquainted that it would be but "discoursing on war in the presence of Hannibal."

The wall discovered first, was about twenty-seven years ago, exposed to view by repeated heavy rains washing a deep *ravine** in the side of a hill of moderate elevation, upon the south branch of the Yadkin River, about eight miles from Salisbury. It is described by Dr. Hall, as being "composed of small stones, laid in white cement, resembling lime of a very fine texture. The largest stones do not exceed twelve pounds in weight, and from that of all sizes down to the weight of an ounce. Specimens from this wall are marked No. 1—the length of these peices makes half the width of the wall, and they are preserved together, precisely as they were taken from it. The aid of a mattock is required to loosen some of them, others may be pulled up by the hand. The species he says is what the Irish call *black whin*, nor is there any other kind of stone to be found in the wall. Mr. Lewis remarks that "the ends of the stones, which are of different figures, form the sides of the wall. Some of the ends are square, others are nearly of the form of a parallelogram, triangle, rhombus, or rhomboides; but most of them irregular. Some preserve the figure and dimensions of the end through the whole length; others enlarge or diminish from the end. The surface of some is plain, of some concave and of others convex. Every concave stone is furnished with one of a convex surface. When the stones are not so exactly fitted as to lie perfectly level and firm, they are curiously wedged with others, which are very small, and of a plano-convex form. The most irregular and unmanageable stones are thrown into the middle of the wall. The whole appears to be arranged in the most skilful manner to make the wall solid and strong." The idea is I think, rather fanciful than correct. A close inspection of the specimens will I believe satisfy you that these little pieces possess that kind of regularity, and conformity to the larger ones, which made them necessary and constituent parts of the solid formation, prior to its separation. He again remarks, that, "every stone is covered with a species of cement. The cement contiguous to the stone, has the appearance of iron rust; and where it

* I use this word for want of an English one to express my idea.

is thin, the rust has penetrated through it, many pieces, however, are found more than an inch thick. In these the cement appears to be of a fine and curious texture; not the least sand or grit is discoverable. In the wet parts of the wall, the middle of the cement which is not discoloured with rust is nearly of the colour, the consistence and soft oily feeling of putty in its softest state. The width of the wall is uniformly twenty-two inches; its height and length have not yet been discovered." All the stones, you will find in various stages of progressive decomposition—some small ones I have found so completely decomposed as to be easily broken by the fingers. The ends of the stones you will observe are incrustated in a similar manner with the sides. The course of the wall is N. East and S. West,—it is enclosed on each side by soft, coarse, granite. Mr. L. further remarks that, "about six or eight miles from this wall, another has since been found, which is forty feet in length, four or five in height, and uniformly seven inches in thickness. These stones are all of one length, but of different kinds. Some are of the iron character, others of a light grey colour, and differing as widely in kind as in colour." There is considerable inaccuracy in this statement, and it may be well to correct it; as it would tend to improper conclusions, and throw the subject into still greater obscurity. About five miles south-east from the above described well (at Robleys,) and four miles north from Sailsbury, near Coquenowers, the rains have washed a furrow in the side of a hill, (as in the former case; and as is indeed, very common in this part of the country,) to the depth of several feet. At the bottom of this is found a wall of precisely similar structure, with the exception of its size. Its course is likewise North-East and South-West. The stones (see specimens No. 2.) are six or seven inches in length, lying across the wall, and forming its width. On comparison, you will find them differing in no respect, in colour, kind, or texture, from those at Robley's nor from each other. This wall is likewise embraced on each side by loose granite; neither its length, nor depth, have been ascertained, nor has any one thought it worth while to engage in a search, likely to prove so unprofitable and indeterminate.

In the course of one of my professional excursions in the country, in 1819, I discovered traces of this stone on the

declivity of a hill, over which the States-ville road passes, half a mile beyond Second Creek, near Gillehans, eight miles from Salisbury. In order to gratify my curiosity, I obtained some hands from a plantation in the neighbourhood, to explore it some short distance. Within twelve inches from the surface, I found a wall pursuing a North-East and South-West course, constructed in the same manner with the others. The stones (No. 3.) lie across the wall, which is about seven inches wide. It possesses all the properties which characterize the others, whether of regularity, colour, and texture of the stones, cement, or any other circumstance. This is also embraced by coarse gravel. My time did not permit me to pursue it to any considerable depth or extent. Two miles South of Robleys, on the plantation of Daniel Biles, I found a vein of it crossing the point of a hill, the specimen is marked No 4. On the Charlotte road nine mile S. S. West from Salisbury, and four S. West from Gillehans, it again makes its appearance on the surface of the ground,; specimens marked No. 5. About a mile from Town on the East, I have lately discovered a wall of similar construction. It makes its appearance in a gutter, worn by the rains in their descent by the highway, on a gentle declivity,—the specimens are marked No. 6. There are many other places, some on the North side of the main Yadkin, to which I could refer if necessary, where there are evident traces of similar veins; most of them lie very near or upon the surface, and a person tolerably familiar with their appearance, can detect them without difficulty. They all, so far as my observation extends, observe the same general course, viz. N. East and S. West. None of these stones are to be found in any part of the country, except in or near these veins.

I have declined meddling with the discussion; touching the question of the origin or nature of these Dykes; but if I might be permitted to express an opinion upon the subject, it would be widely different from the one advanced by both these reverend gentlemen. They seem to have no difficulty in arriving at the conclusion that these walls are the result of human skill and industry, and have indulged in a number of curious conjectures as to their probable design. The opinion given by the late Dr. Woodhouse, professor of Chemistry in the University of Pennsylvania, in his reply

to Dr. Hall, would seem to me much the more rational and philosophical, viz. that they are basaltic. Although the position of these walls is in some degree an anomaly in the history of basaltes, yet I think there is sufficient analogy for the support of the opinion. The comparative analysis by Dr. Woodhouse of these stones, *rust and cement*, (see Med. Repos. Vol. II. p. 259,) with those made by Bergman, Monges and others, of the basaltes of other countries; the perfect unity in kind, of all the stones in the same wall, and the near resemblance they bear to the specimens of basalt in my possession, together with the following description given by Cleaveland, render the thing conclusive in my mind.

The most common colour of Basalt, says Professor Cleaveland, "is greyish black, sometimes inclining to brownish grey, and sometimes to brownish or bluish black | Some varieties have a tinge of green. The exterior is often brown, or reddish brown, in consequence of decomposition. The colour of its streak is a light grey. It is opaque, or sometimes feebly translucent at the edges. Its fracture is usually uneven or fine splintery, sometimes a little conchoidal, earthy, or nearly even. It has no lustre, unless from the presence of foreign substances. It is difficult to break, and frequently sonorous when struck. It is more or less subject to decomposition, partly, at least, in consequence of the action of the atmosphere upon its Iron, which exists in a low state of oxidation, as is evident by its action upon the needle. Hence the brownish, friable, or even earthy crust, which often invests its exterior. Those Basalts, which seem to approach very near to green-stone, decompose most rapidly. Indeed the whole mass is sometimes converted into an earthy, argillaceous substance." Mr. C. however, thinks it extremely doubtful whether any basalt, strictly speaking, has yet been discovered in the United States, but that the columnar and prismatic masses which exist in various parts of the United States, are undoubtedly a *secondary basaltiform greenstone*; which, in some cases, may perhaps be *passing into* basalt.

If then the fact be established, that these stones are basaltic, I presume it will hardly be contended that they were collected from, nobody knows where, to form a number of parallel walls, of a length and depth which no man can calculate.

As to the question of their origin, whether aqueous or volcanic, I dare not, with my limited knowledge of Geology, hazard an opinion. I would however, with great diffidence, and with submission, question the correctness of Dr. Woodhouse's decision. He believed them to be of volcanic origin, and founded his opinion upon a belief that there are volcanic appearances in this section of country. Such there may be; but I have never heard of, or seen any traces which could lead to such a conclusion. If they had their source in one common point, would not their course be divergent rather than parallel, especially as they are several miles apart? Does not the fact that they observe the same general course with the great range of mountains in this country, and of our atlantic coast, argue something in favour of a belief that they are an aqueous deposit?

In the box you will find some small specimens of kaolin (No. 7); my largest pieces I some time since sent to Professor Olmstead, of our university, and have not since had an opportunity to obtain more. It is found on a spur of the Tryon mountains, called Flat-Swamp mountain, running up north from the narrows of the Yadkin river, to within seven or eight miles of Lexington. The summit is composed of granite and quartz chiefly. On the sides this clay is found in immense quantities, thinly covered with gravelly earth. The foot of the mountain on the East, together with the plain below, is covered with this clay in fine powder, washed down by the rains. This plain had long been the resort of cattle for the purpose of licking the absorbent earth, particularly in the spring. People in the vicinity considered it a *salt-lick*. Accordingly, when during the late war salt became a scarce and expensive article, their attention was directed to this spot, as likely with a little labour and expense to furnish a supply, and become a source of considerable revenue. About this time a crafty fellow, a miner from some part of Europe, passed this way, and determined to convert their credulity into ready money, if he could not their clay into salt. He sunk a shaft about sixty feet, then commenced boring, and pursued it to the depth of eighty feet more. Their funds or their patience were now exhausted, and their suspicions of fraud awakened; the knave, pocketing his wages, coolly told them that, *if they would go deep enough*, they would be sure to find salt, and walked off.

In the course of their digging they passed through a thick bed of roof slate, of a dark bluish colour. Indeed, this section of country abounds in beautiful slates. Broad veins of it may be found running in various directions from this mountain, chiefly South-West; it is slightly inclined to the North. Some cross the river, and run through the country to a considerable extent.

No lime-stone has been found in this county, except a small quantity of the species called Tufa, specimen No. 8, which I discovered in the neighbourhood of Salisbury. I likewise send you some petrifications of shells, found in great abundance on the plantation of the Hon. William C. Love, near Knoxville, East Tennessee, and presented to me by him. You have doubtless received many from that country before; but one of them is to my view of so curious an appearance, that I cannot withhold it (see No. 9). If we did not know that the species of fungi called toad-stool, are subject to such rapid decay as to render them improbable subjects for this process, I should strongly suspect it was one of them.

In this rapid sketch, I fear I have but very imperfectly answered your queries. If however, the information contained in it should contribute to settle the once violently agitated question concerning the nature of these walls, and correct the erroneous opinions entertained by many respecting them, it may not be wholly useless. Should you think proper so to arrange and dispose these materials, as to answer this or any other purpose, they are perfectly at your service. With the highest respect

for your literary and private character,

I am, dear Sir, your most ob't serv't,

JNO. BECKWITH.

SAML. L. MITCHELL, M. D.

President of the New-York Lyceum of Natural History.

ART. II.—*A Geological Section of the Canaan Mountain, with observations on the soil and productions of the neighbouring region; by D. H. BARNES, M. A. member of the New-York Lyceum.*

Read before the Lyceum, January 14, 1822.

CANAAN MOUNTAIN is situated three miles south-west from the Lebanon springs, in the county of Columbia, and state of New-York. It is an insulated ridge of about four miles in length, from north to south, bounded on the north and east by the valley of Lebanon; on the south by a triangular lake, of about two miles in extent, called Whiting's Pond; on the west by a tract of low meadow land, on a part of which is a deep quagmire, with a pond of water in its centre, called Adgate's Pond. Contiguous to this swamp, on the south-west, is another, containing about twenty acres of surface, in the centre of which is a *prairie*, which according to tradition, was formerly covered by a *beaver pond*. From Adgate's pond a stream flows north, and another south. These meet in the Kinderhook river, a branch of the Hudson.

The height of the mountain from its immediate base,* does not exceed one third of a mile. The line of our section crosses the highest point, known in the vicinity by the name of *the high knob*, about fifty rods north of the line which divides the townships of Canaan and New-Lebanon. Commencing on the western side, in the low grounds before mentioned, the first remarkable object that strikes the observer is an extensive bed of *peat*(a)† It abounds in the adjacent swamps, so much that the quantity has been judged sufficient to supply the town with fuel for a thousand years. Specimens of this, and of the other minerals mentioned in this description, are on your table; and I have the pleasure of presenting them to the Lyceum. This *peat* is not at present used as fuel, on account of the abundant supply of wood which the yet uncultivated mountain affords. An attempt was made in the years 1803 and 1804 to bring the ar-

* The base itself is high land.

† These letters refer to the subjoined catalogue of minerals presented at the reading of this paper.

ticle into the market; but it failed, and has been since abandoned. The opening for this purpose, was made by Jessé Torrey, on the land of Andrew Hunter, in the township of New-Lebanon, about half a mile north-west of the springs. The peat of the upper part of the bed is coarse and light, but at the depth of three feet its texture is fine and compact, and its colour a deep chesnut brown. It burns with a clear white flame, and in general resembles that described by the Rev F. C. Schaeffer, in the Am. Jour. of Science, Vol. I. pp. 139 and 140. The peat of this region is supported by a *fine blue clay*, remarkably viscid and tenacious, and free from all other substances. It is used for setting vats and cisterns, and is a good material for making brick. The soil of the low grounds is well adapted to the growth of grass, and where it can be sufficiently drained, to the growth of grain also. The prairie is surrounded by an abundant growth of swamp ash, *Fraxinus Juglandifolia*; elm, *ulmus Americana*; soft maple, *acer rubrum*; and alder, *alnus ser-rulata*. The shrubs are chiefly berry-alder, *Prinos verti-cillatus*; several species of willow, *salix*; and spice-bush, *Laurus Benzoin*,

Ascending the **FIRST STEP*** of our section, we find a solid table land of a clayey loam. It is a good strong soil, but tough, and of difficult cultivation. Wheat and rye sown on it are frequently "winter-killed." The surface is overspread with bowlders of gray-wack(b), and *white quartz*(c). The gray-wack appears to be the ruins of an extensive stratum not at present found in place, any where in this region, to which my observations have extended. It is of the coarse granular kind denominated rubblestone,† and appears to have had its position immediately *above* the *highest* rock in our section. It is sometimes of a *porphyritic structure*,(d) as appears from the specimens before you. Wells sunk in this table-land give us frequent opportunities of observing the *sub-soil*, or what the farmers call the "*hard-pan*." It is the blue clay of the peat bottoms with a large admixture of gravel, so firmly cemented as to render it difficult to be broken up with a pick-axe. Wells of the usual diameter, are sunk to any required depth without the least danger of "cav-

*See the plate.

†Eaton.

ing in." The substance thrown out is totally unfit for vegetation, and has been known to lie exposed for forty years without acquiring a turf. The roots of no tree penetrate the *hard-pan*. The white-pine, *Pinus strobus*, marks most distinctly the first elevation from the peat bottom. In this situation it shoots forward its roots to a great extent horizontally, and when this majestic tree is prostrated by the wind, the subjacent clay is discovered impressed, but not penetrated, by the roots.

At the SECOND STEP of our ascent we meet the first rock which occurs in place. It is limestone,(e) and probably one of the oldest members of the *transition class*. It ranges north and south, and dips to the east, with an inclination in various parts of from twenty to forty degrees. It makes excellent lime; of which, in former years, large quantities were burnt for building. It is of a beautiful light blue, fine grained, nearly compact, and receives a good polish. It was formerly wrought for the New-York market. It was sold at one dollar the square foot, and can still be seen in houses built twenty-five or thirty years ago. Six quarries were opened, from one of which slabs were taken out fourteen feet in length. The rock presents perpendicular fissures parallel to each other, which are crossed at right angles by natural joints. It also shows on the sides of the fissures, very regular and convenient divisions into tables, which require only the driving of wedges to be separated. It is thus easily quarried, after removing the incumbent substances, which are chiefly earth, and an inferior kind of limestone,(f) which contains an admixture of very fine silicious particles. It is this, or a very similar rock from a locality five or six miles east of this, which was brought last summer to this city, under the strange delusion of its being "*Plaster*" (gypsum.)

On the margin of a brook in this vicinity, is found a very fine sand,(g) which may perhaps have been formed by the disintegration of the silicious lime-stone. The sand is so very fine as to appear to the naked eye like clay. Under the microscope however, it shows its real character. It is used, instead of Tripoli, for cleaning and polishing metals. It has been tried in this city, and answers the purpose well. Specimens of this last mentioned rock, from the out-burst of the stratum, on the east of the mountain, are before you.

They exhibit an uncommonly regular rhomboidal fracture.(h) They effervesce briskly with acids, and give fire freely with steel.

By taking an *offset of four miles North*, from the place of our section, we discovered the stratum on which the limestone rests. It is the *Lebanon roofing slate*, (i) which being of an excellent quality has been extensively wrought and transported to this city. It is inclined to the East, at an angle of about twenty degrees, and as it occupies the face of a side hill, of the *same inclination*, it is easily quarried. It is traversed at considerable distances by parallel seams of white quartz.(i) The formation is so perfect that slates of thirty square feet of surface, are frequently taken out, and much larger tables might easily be raised if required. South-east of this quarry, and distant about one mile, is the celebrated *Lebanon Spring** in limestone(j) which from its dip, direction, inclination, structure, and geological position, appears to be the same as the rock of our section. It ranges north and south, and inclines to the east, with an angle of twenty-five degrees, while all the other rocks, which I have observed in the adjacent region, dip towards the south-east, and range north-east and south-west. It was this remarkable difference in the stratification, that first attracted particular attention to the insulated ridge under consideration. The soil of the limestone is good where it is of sufficient depth, but throughout the greater part of this tract the rock approaches too near the surface.

The principal trees of this tract are beech, *Fagus ferruginea*; sugar maple, *Acer saccharinum*; dogwood, *Acer striatum*; (shrub) chesnut, *Castanea Americana*; birch, *Betula rubra*; walnut, *Juglans squamosa*; butternut, *Juglans cinerea*; ironwood, *Ostrya virginica*; witch hazle, *Hammamelis virginica*; sassafras, *Laurus sassafras*. The vitis

* The waters of this spring have been analyzed by Prof. Griscom, and his analysis published in Bruce's American Mineralogical Journal, page 156. It has lately been discovered, that a soft friable substance resembling Tufa, has been deposited from the water. On digging in the canal that forms the outlet of the spring, and on which Tryon's Mill stands, this substance(v) was thrown out in considerable quantities. This deposit differs from the high rock at Saratoga springs,(x) by its more uniform colour, by being lighter, softer, more friable, and containing little or no iron, which abounds in the Saratoga Rock.

12 Mr. Barnes' Section of the Canaan Mountain, &c.

vulpina or frost grape grows abundantly, and overtops many of the trees of the second growth. The limestone rocks are the favourite haunt of the *helix albolabris* of Say the common snail, retaining the same manners as in ancient times, "*inter saxa repentes*."*

The third step in ascending Canaan mountain, brings us to a thin stratum of *white quartz*, which appears to have furnished the bowlders before mentioned. This rock is *tabular*, the tables standing very nearly perpendicular, and in many places it exhibits regular crystals on the edges(k) of equal thickness with the tables. The specimen(c) before you has a surface of fifty square inches, and is about one inch thick. This was procured at the surface and detached with a crow-bar. By making a small excavation, and using wedges, it is believed much larger tables might be obtained. This rock mixes on the one side with the *limestone*(l) and on the other, with *argillaceous slate*(m) which is the *fourth stratum of our section*. This slate presents a considerable diversity of colour and structure. Some of it is soft and earthy, while other specimens are hard and flinty. Its colours are light grey, green, ferruginous, and dark blue approaching to black. Some specimens both of the limestone and the slate are glazed on their edges with *talc.*(o) *crystals of pyrites*(p) are numerous, and some of them are an inch in diameter, but have very little or no lustre on their faces. They seem to have been formed before the slate, which is in many instances *bent round them.*(q) This slate covers all the hills of a moderate height in the vicinity. The soil of these hills, which was formerly esteemed very poor, is now much improved† and constantly growing better; while the contrary is observed of the valleys, which will probably continue to deteriorate, until our farmers shall learn to plough fewer acres, and manure those better. The timber of this part of our section and that which grows on corresponding heights of the circumjacent hills is principally chesnut, *castanea Americana*; much used for fences and building; white birch, *Betula papyracea*; white oak, *Quercus alba*; "the most useful timber tree in America;"‡

* Vide Sallust. Bell. Jug. Cap. xciii.

† See Spafford's Gazetteer, and Eaton's Index.

‡ Eaton.

black oak, *Quercus tinctoria*; red oak, *Quercus rubra*, et *coccinea*. The springs, which flow from the slate rocks, are remarkably pure water, and much esteemed for their softness and salubrity, the more so by contrast with the limestone water below, which is very hard.

This slate, in the township of New-Lebanon, assumes that variety called *alum slate*.(r) It is found on the land of Nathan Patchen, north of the springs. It occurs in a high and almost perpendicular bluff from the interstices of which constantly exudes the aluminous matter incrusting the specimens before you. It is highly acrid to the taste, and may probably become useful in the arts.

The fifth step is *Graywack slate*.(s) which caps all the high hills in the vicinity, and is the uppermost stratum, known in place on the mountains which lie immediately west of the primitive region of New-England.

Above the Graywack slate, as formerly hinted, the Graywack rubblestone appears to have had its position. It is evidently the result of mechanical deposition, and answers perfectly to the description of this rock given in the New Edinburgh Encyclopædia, under the head of Mineralogy. The remains show that the stratum must have been of very great extent, and probably of vast thickness. Masses of this rock are found of from ten to fifty feet in diameter, and of a weight resisting any ordinary human force. By taking advantage, however, of their natural composition, they are easily removed, whenever they are opposed to the course of a turnpike, or impede the erection of a house. The method is simply to build a large fire, of dry logs upon them. The argillaceous cement is contracted by the heat, and the mighty mass is split into a thousand fragments. These fragments are commonly of a trappose form and thus become exceedingly useful for fences and buildings. From the Graywack slate upward, the strata are repeated in the same order as before enumerated, viz. limestone,(e) quartz,(c) argillaceous slate,(n) and Graywack slate.(s) The last forms the highest part of the "high knob." The appearance is the same as it would have been, if a large mass, of the same range, had been raised from its bed, and piled, like Ossa on Pelion, upon the top of the mountain.

The Peak is of tolerably easy ascent from the north,* but on the south the beetling crags overtopping the highest trees are wholly inaccessible. The eastern and western sides are precipitous, but can be ascended with care and labour by taking hold of the shrubs and projecting points of the rocks. The large mass of Graywack slate that caps the summit is stratified and inclined towards the south-east, differing in this respect, from every rock below it. The timber on the upper half of the mountain is similar to that on the lower half. The white pine which grows at the bottom, appears again in the middle region, where the limestone is repeated. The summit is crowned with pitch pines, *pinus rigida*; with an undergrowth of blue and black whortleberries, *vaccinium frondosum et resinosum*. This is an elevated and bleak region, and the rocks as well as the stunted trees, appear to bear marks of the pelting storms, and to have grown hoary, by the lapse of ages. Every thing here reminds us of the grand elevation to which we have attained. The quickened respiration, the sharp blast that whistles through the moss-grown pines—the absence of nearly all the tenants of the woods, both winged and quadruped—the lengthened prospect, and extended horizon.

The prospect is worthy of the toil required to obtain it. We look down as on a map on all sides. Turning to view the path by which we ascended, the house at the base of the mountain appears under our feet. At a little distance on the right, Adgate's Pond shines like a silver basin, through a nook of the mountain. On the left, the regularly planted orchards, and the richly cultivated fields, present the beauty of a garden, and the softness of a picture. The meadows beheld with a bird's-eye view, exhibit the smoothness of a level lawn. The woodlands appear like scattered clumps of trees designed to adorn a pleasure ground. The whole is so perfectly in view, and so diminished in size, that we can scarcely believe it to be of its well known extent.

"'Tis distance lends enchantment to the view,
And robes the" landscape "in its" magic "hue."

On the north-east "the vale of Lebanon," celebrated by travellers for its romantic beauty, thickly scattered over

* See profile.

with houses, and gardens, and orchards and groves, presents the beauty of a populous village, and the variety of a cultivated country. On the east, Hancock mountain rises with a bold swell, adorned on the side nearest the observer, with the village of the New-Lebanon Shakers, visited by every traveller, and celebrated for its peculiar neatness and simple elegance—for its rich gardens, and highly cultivated fields—for the regularity of its buildings, and the elegance of its manufactures—for the celibacy of its inhabitants and the inoffensive simplicity of their manners. Beyond the vale of Lebanon, and distant twenty miles, *Saddle mountain* “the highest land in Massachusetts” rears its broad *double back* to the skies, and from its cloud-capt height looks down in grandeur on the inferiour world. Turning again to the west, and extending the view, we perceive the hills gradually declining, and catch a glance of the Hudson River at the distance of twenty-four miles, with the white sails of vessels on its surface, alternately appearing and disappearing, as they float in the wind. The richness and the variety, the sublime extent and picturesque beauty of this scene are equalled by few in our country. Beyond the Hudson, Catskill mountains robed in azure hue, and steeped in hazy distance, rise to view in long parallel ranges “height o’er height” to the clouds, and like Atlas appear to support the heavens on their shoulders. This grand panorama is bounded by one of the most sublime objects in nature, and the pleasure felt in the contemplation of the nearer view, yields to astonishment at the grandeur of the more distant prospect.

Disruption and sinking of the Strata.—The whole of the rock formation, described in this paper, appears to have been *broken off* from the primitive tract on the East of it, and to have *sunken down* about *one thousand feet perpendicularly*. We had no means of accurate admeasurement. We estimated the distance by comparing it with other ascertained and well known heights. Hancock mountain is a part of the same mean height as the Highlands of the Hudson. The average of the four highest points mentioned in Dr. Akerly’s “*Geology of the Hudson River*” is fourteen hundred and seventy feet. Allowing the highest peaks to be one fourth higher than the mountain generally, we shall have eleven hundred feet as the permanent elevation. It would therefore

appear that the height of the Hancock or as it is often called Pittsfield mountain may be safely estimated at one thousand feet, and the strata seem to have fallen the whole height of the mountain. This appears from the position of the strata in the mountains. The lower stratum of limestone described in the section is at the same height on both sides of the Canaan mountain. It is associated with slate. This Limestone part of which is silicious, is found with slate on the top of Hancock Mountain. It was also observed on the top of a mountain in Lee, fifteen miles South-East of our section. These two strata thus associated on the *top* of Hancock, and at the *base* of Canaan mountain, may perhaps without impropriety, be considered as parts of the same original bed, which has been disrupted by some mighty force, and while the Eastern part remained firm, the Western has settled down to its present position. The roofing slate is probably primitive, but whether it is so, or not, its position must have been *above* the white granular Limestone of Pittsfield.*^(y) This limestone is on the surface, and clearly a primitive rock. But the elevated table land of Pittsfield, is several hundred feet higher than the low valley of Lebanon, so that the strata must of necessity, either have been bent rapidly downwards, or broken off and fallen perpendicularly. That the strata have dropped in situ, and not bent downwards, as Prof. Eaton supposes, appears from the *horizontal* position of the great masses of mountain strata, in our section, and also from the fact that the slate is found at the same height, on all the circumambient hills; and the limestone at the same depth in all the circumjacent valleys, and the graywack at the same elevation, upon the neighbouring mountains. This last rock is, moreover *laid bare*, to a great extent in that part of the mountain which lies South of the High Knob. Here the whole formation is perfectly open to inspection. The upper surface is horizontal. This surface is composed of the upper edges termed in geology, the out-goings of the strata, for it must be carefully observed that although the rocks are stratified and the strata highly inclined, yet the great beds or mountain masses are disposed, above each other horizontally, and these beds or

*I take for granted the truth of the Wernerian theory, as it regards the general order of the super-position of the rocks. See President Maclure's Geology of the U. S.—Professor Eaton's Geological sections, and Professor Cleaveland's Mineralogy.

masses are termed strata when in general we speak of geognostic relations.* A curious miniature instance, of the stratification of which we are speaking, and one which corroborates our supposition, that the strata have subsided horizontally; was observed in the township of Chatham, four miles westward of our section. The road passes through a hill of slate-rock which has been excavated to open a passage. This slate like almost all the other rocks in this part of the country, is inclined south-eastwardly or *towards the ocean*. Parallel seams in this rock are filled by rhomboidal quartz, (aa.) which is perfectly horizontal in its direction. This quartz in its disposition, so exactly resembles the fibrous *sulphate of* (bb.) *Barytes* at Carlisle that at the first sight the impression was strongly made that it was the same mineral but on approaching the bluff, the illusion vanished. This quartz is very remarkable. The strata are horizontally not more than an inch or an inch and a half thick, parallel, and all the fragments, like those before you, of a regular rhomboidal form. The rock in which the quartz is disposed, is a soft argillaceous slate, which is so rapidly decomposing into the soil of the hills before mentioned. The supposition, that the strata have been separated, and that the western part has fallen down to its present level is confirmed by a reference to Maclure's sections which show in this range, the transition on the west reclining against the primitive on the east. In his northernmost section, the transition is lower than the primitive, in the next section, the two are of an equal height; and in the part which we are considering the transition is a little higher than the primitive. By a reference to Maclure's or Cleaveland's Map, it appears, that the line on which the two formations meet, runs north and south, from Canada to the highlands, on the Hudson. This line traverses the Green mountain. The two formations meet at its top. So here, the Hancock mountain is in the same range, as the Green mountain, and very near south of it, and the two formations meet at its top. The fact that the two formations butt against each other in a line nearly straight for more than three hundred miles, cannot perhaps in any other way, be so satisfactorily accounted for, as by supposing that some mighty convulsion has rent asunder the Continent from the St.

* See plate.

Lawrence to the Ocean. What that force was, that could operate with such tremendous energy as to rive "the everlasting hills," through a space of three hundred miles, may be left to the Plutonians and Neptunians to determine. That it operated from *beneath* is probable, and that after it had opened for itself a vent, and escaped through the rift, caused by its action, the rock-strata, of the Western part, fell into the cavity which had previously contained the imprisoned agent. This supposed disruption will account for the course of the River Hudson and its passage through the highlands : and also for the position of Lake Champlain, which probably at some more remotely distant period, was the outlet of the great inland sea that once covered the country above the highlands. That the lowest part of the fallen or subsided tract, should be at some little distance, from the line of its disruption might naturally be expected, for the western part, in falling, would impinge against the eastern, and be in some degree supported by it, causing the strata to bend and form a *hollow* on the upper surface. That *little distance*, on the grand scale of operations which we are considering is from twenty to thirty miles, and the *hollow* is occupied by Lake Champlain, and the River Hudson. If, as we have supposed, some mighty force operating from below raised up this tract, and while the part eastward of the rift remained firm, produced a disruption, it would be natural to expect that some *other traces* of its operation, should be found on the *other side* of the tract. Such traces, in fact are found and they are so distinctly marked, as to produce a powerful confirmation of our supposition. In the counties of Warren, Washington, Montgomery, and Saratoga, westwardly of the general course of Champlain and the Hudson, *exactly where we should desire* we find the western limit of this tract "butted and bounded" by the primitive through a distance of more than one hundred miles. On this subject I refer you to the respectable authority of Prof. Eaton, and to Dr. J. H. Steel's excellent treatise on the mineral waters of Saratoga, to which he has prefixed a geological Map with observations on the geology of the surrounding country. Steel says, pp. 11, and 26, "*The eastern side of the Palmertown range (primitive) commences abruptly and in many places presents an almost perpendicular front, that rises several hundred feet above the level of the plain that skirts its base.*"

This plain, he describes, as either transition slate and Graywack, or in some small part, secondary, "approaching the foot of the Palmertown mountain" and "in this manner it continues along the base of the mountain." Eaton says, (supposing a force to have been applied beneath) "At this place it happened to break through them all at once, forming a north and south fissure of twenty or thirty miles in extent. All the strata on the east side of the fissure, fell back nearly entire and still remain so, with the compact limestone covering the whole, which in some places meets the granite so closely that it may be compared to a board scribed up to a wall by a carpenter." Eaton's index, 2nd Edition, p. 108.

No confirmation is needed in support of such respectable authority which, however, will be fully confirmed and illustrated by a personal inspection and examination of the country described.

We have before taken for granted the Wernerian order of superposition of rock-strata, we here remark further, that it does not appear probable that the transition, most of which contains no organic remains; or even a great part of the secondary, that, namely, which contains the petrified remains of marine productions, now extinct, is of later origin than that tremendous catastrophe of our globe in which "all the fountains of the great deep were broken up, and the waters prevailed greatly" and "exceedingly and all the high hills, and the mountains under the whole heaven were covered." If at the period when the continents were broken up" and submerged, and the earth and sea were commingled; the tract, of which we are speaking, sunk to a lower level than the adjacent tract of primitive, it would in that situation be protected from wearing down, while the higher and soft strata, over nearly all New-England, would be washed away. We say nearly all, for there are two small tracts, one of transition, and the other of older* secondary remaining. The secondary† lies in the deep valley of the Connecticut river, and the transition extends from Providence to Boston, on a level with the surrounding country. Both are in situations to be protected in the manner before mentioned.

* Or transition.

† Old red sand stone.

If the earth on which we live is composed of "the fragments of an earlier world, confusedly hurled together;" and of that, even without revelation, we have demonstrative proof in every part; we need not wonder why New-England is mostly primitive, and New-York mostly secondary. Why the Catskills are gray-wack, and the Rocky mountains granite. Why the Ural mountains are quartz, and the summits of the Andes clink-stone.

When we contemplate the immense tracts of sand and alluvion, we cease to inquire what has become of the ruin rent from the ragged mountains, or furrowed out from the deep valleys. When we observe that the valley of the Nile is not alone a watered garden—that the valley of the Mississippi contains vastly greater tracts, scarcely yet emerged from the flood—when we see that Atlas not alone looks down on an ocean of sand—that the Rocky mountains have their Zahara on the east, of seven hundred miles broad, and of length unknown—when we survey the globe in its extent; and to that the science of Geology has respect—we cease to inquire what has become of the ruin produced by the demolition of mountains, and the destruction of continents.

Iron Ore.

The boundary between the primitive and the transition, is the depository of a very extensive tract of Iron Ore. The ore-beds in Kent and Salisbury, (dd) the beds in Lee, (cc) Richmond, Hancock, New-Lebanon, (ee) several in the counties of Rensselaer and Washington; the great range of iron ore in Vermont, and on Lake Champlain, exhibit evidences of a continuity in this formation of iron, from near the ocean to the St. Lawrence. This tract of iron ore ranges north and south, and, for aught at present known to the contrary, may extend to the pole, the central point of magnetic attraction. Are there, in other places, any similar instances of a polar direction, in the beds of iron ore?*

Accompanying this range of iron ore is a range of white granular lime-stone, (y) from the ocean to Canada. This is affirmed to be the true metalliferous lime-stone of authors.

*Immense beds of magnetic iron ore extend, with little interruption, from Canada to the neighbourhood of New-York.—*Bruce's A. M. Jr.* p. 81.

Lead Ore.

The blue limestone(e) of Canaan passes at some considerable depth into a lighter colored stone, approaching the white granular limestone of Stockbridge.(y) In the southern part of the township of Canaan, this limestone(t) is the gangue of a fine steel-grained lead ore(u). It was formerly wrought, but the expense proved too great to justify its continuance, and it is now abandoned, and the mine filled with water. Galena, mixed with pyrites, is found in abundance, in the southern part of the county of Columbia, not far from Ancram iron works. It is on the borders of the transition, directly south of that mentioned above. It is a very rich ore, but has not been wrought to any great extent.

Catalogue of Minerals illustrating the foregoing remarks.

a. Peat, 1 Hunter's, 2 Adgate's swamp,	New-Lebanon.
b. Gray-wack Rubblestone,	Canaan.
c. Tabular Quartz,	do.
d. Porphyritick Gray-wack,	do.
e. Limestone,	do.
f. Silicious Limestone,	do.
g. Fine Sand,	New-Lebanon.
h. Rhomboidal silicious Limestone,	do.
i. Roofing slate, with white quartz seams,	do.
j. Limestone,	Pool-Hill.
k. Quartz Crystals,	Canaan.
l. Quartz with Limestone,	do.
m. Quartz with slate and crystals,	do.
n. Argillaceous Slate,	do.
o. Slate and Limestone with Talc glazing,	New-Lebanon.
p. Cubic Pyrites with slate bending round them,	do.
q. Pyrites in Slate with Talc glazing,	do.
r. Alum Slate and native Alum,	do.
s. Gray-wack Slate,	Canaan.
t. Limestone from the Lead mine.	do.
u. Limestone and Lead ore,	do.
v. Deposit from Lebanon Springs.	
w. Water-Lime from Onondaga and Carlisle.	
x. High rock at Saratoga.	
y. White granular Limestone,	Richmond.
z. Iron ore from	do.
aa. Rhomboidal Quartz,	Chatham.
bb. Fibrous sulphate of Barytes,	Carlisle.
cc. Iron ore,	Lee.
dd. Iron ore,	Salisbury.
ee. Iron ore,	New-Lebanon.

22 *Professor Eaton on a singular deposit of Gravel.*

ART. III.—*On a singular deposit of Gravel; by Professor A. EATON.*

TO PROFESSOR SILLIMAN.

Sir,

I HAVE just taken the measure of a deposite of several hundred cart-loads of gravel, made by the river Hudson, on Monday, the 4th inst. thirty-four feet higher than the highest point to which it rose during the time of making the deposite. This apparently paradoxical statement may if particularly described, and deposited among other facts in your scientific store-house, contribute a "mite" towards the solution of some geographical phenomena.

This deposite, consisting wholly of coarse gravel, is on the east side of the great canal cut through the glazed slate rock for the sloop lock, two hundred feet west of my house at the Old-Bank Place, near the north boundary of the city of Troy. It is necessary to state that the canal commissioners have directed an artificial bay to be formed here; wherein the branches of the great western canal which first meet the waters of the Hudson are to terminate, into which sloops are to enter by the aforesaid lock. The lock is already erected about half across the river, from the western shore. It being unfinished in the eastern half of the river, the water is pressed with great force against the east bank.

I need not mention that the uncommon and long continued severity of the past season has formed the ice of the Hudson of uncommon thickness. It broke up suddenly here, and moved down on Monday the 4th, not with great velocity, but with a degree of force which seemed to threaten even the shores of solid rock. Pressing against the little rock promontory across which the aforesaid canal is cut, cakes of ice shot over, and soon filled the canal. Other cakes pressing against the bottom of these, crowded them up to a considerable height above the water. At length an enormous ice cake appeared, bearing on its back a great quantity of gravel. This began to press against the heaps of ice already formed, which bore much gravel also. Innumerable other cakes from behind, pressed on by the unconquerable waters of the mighty Hudson, soon forced the largest cake across the canal, and up the eastern bank, so that its eastern

edge extended thirty-four feet higher than the surface of the water, carrying up hundreds of smaller cakes to the same height. This mountain of ice having taken its stand here, is now melting away, and leaving the gravel on the bank, which it transported from the northern counties.

I do not record this as an uncommon occurrence. But since it seems to be a rule among geologists to trace the derivation of alluvial deposits to localities more elevated than those where they are found, it may be well to remind them of contingencies of the above nature.

Respectfully yours, AMOS EATON.
Troy, N. Y. March 12, 1822.

ART. IV.—*Honorable notice of Mr. Schoolcraft's memoir of a Fossil Tree.*

REMARKS.

IN our last we published the substance of the Memoir of Mr. Schoolcraft on the fossil tree of the river des Plaines. Having been favored with copies of letters on this subject, addressed to the author by the three American Ex-Presidents, we presume, of course, that the public will be gratified by the perusal of the remarks of these distinguished men.

“QUINCY, 27th January, 1822.

“Sir,

I THANK you for your memoir on the fossil tree, which is very well written, and the conjectures on the process of nature in producing it, are plausible and probable. It is the most remarkable exemplification of petrification that I have ever met with, although I have seen many that I thought curious. I once lay a week wind-bound in Portland road in England, and went often ashore, and ascended the mountain from whence they get all the Portland stone which they employ in building. In a morning walk with some of the American passengers of the *Lucretia*, capt. Calahan, we passed by a handsome house at the foot of the hill, with a handsome front yard behind it. Upon the top of one of the posts of this yard, lay a fish coiled up in a spiral figure, which caught my eye. I stopped and gazed at it with some curiosity: presently a person in the habit and appearance of a substan-

tial well-bred English gentlemen, appeared at his door, and addressed me—"Sir, I perceive that your attention is fixed upon my fish. That is a conger-eel, a species that abounds in these seas. We see them repeatedly at the depth of twelve feet water, lying exactly in that posture. That stone, as it now appears, was dug up from the bowels of this mountain, at the depth of twenty feet below the surface, in the midst of the rocks. "Now sir," said he, "at the time of the deluge, these neighbouring seas were thrown up into that mountain, and this fish lying at the bottom was thrown up with the rest, and there petrified in the very posture in which he lay." I was charmed with the eloquence of this profound philosopher, as well as with his civility, and said that I could not account for the phenomenon by any more plausible or probable hypothesis. This is a lofty hill, and very steep, and in the road up and down, there are flat and smooth rocks of considerable extent. The commerce in Portland stone frequently calls for huge masses from ten to fifteen tons weight. These are loaded on very strong wheels, and drawn by ten or twelve pair of horses. When they come to one of those flat rocks on the side of the hill, where the descent is steep, they take off six or eight pair of horses, and attach them behind the waggon, and lash them up hill, while one or two pair of horses in front have to drag the waggon and its load, and six or eight pair of horses behind it, backwards.

I give you this history by way of comment on Dr. Franklin's famous argument against a mixed government. That great man ought not to have quoted this as a New-England custom, because it was an English practice before New-England existed; and is a happy illustration of the necessity of a balanced government. And since I have mentioned Dr. Franklin, I will relate another fact, which I had from his mouth. When he lived at Passy (near Paris) a new quarry of stones was opened in the garden of Mr. Ray de Chaumont, and at the depth of twenty feet was found, a shark's tooth in perfect preservation, which I suppose my Portland friend would account for, as he did for his conger-eel, though the tooth was not petrified.

Excuse this whimsical letter, accept my repeated thanks for your memoir, and believe me to be

Your obliged friend, and humble servant,

JOHN ADAMS."

MONTPELIER, Jan. 22, 1822.

Sir,

I have received the copy of your memoir on the fossil tree, which you politely forwarded. Of the decisive bearing of this phenomenon, on important questions in geology, I rely more on your judgment than my own.

The present is a very inquisitive age, and its researches of late have been ardently directed to the primitive composition and structure of our globe, as far as it has been penetrated, and to the processes by which succeeding changes have been produced. The discoveries already made are encouraging; but vast room is left for the industry and sagacity of Geologists. This is sufficiently shewn by the opposite theories which have been espoused; one of them regarding water, the other fire, as the great agent employed by nature in her work.

It may be expected that this hemisphere, which has been least explored, will yield its full proportion of materials towards a satisfactory system. Your zealous efforts to share in the contributions, do credit to your love of truth and devotion to the cause of science, and I wish they may be rewarded with the success they promise, and with all the personal gratifications to which they entitle you.

With friendly respects,
JAMES MADISON.

"Th. Jefferson returns his thanks to Mr. Schoolcraft for the memorial he has been so kind as to send him on the fossil tree of the river des Plaines. It is a valuable element towards the knowledge we wish to obtain of the crust of the globe we inhabit: and its crust alone is immediately interesting to us. We are only to guard against drawing our conclusions deeper than we dig. Mr. Schoolcraft is entitled to the thanks of the lovers of science for the preservation of this fact: he has those of Th. J. with his salutations of esteem and respect.

MONTICELLO, Jan. 26, 1822.

ART. V.—*Geology, Mineralogy, Scenery, &c. of the Highlands of New-York and New-Jersey. Read before the Catskill Lyceum of Natural History, by JAMES PIERCE.*

[Communicated for insertion in this Journal.]

General description and Geological character.

THE elevated mountain range called the Highlands, is a continuation of a primitive chain, that commences in Canada, passes through Vermont, and forms the western boundary of Massachusetts and Connecticut.

The Highlands present parallel ridges, which pass from north-east to south-east, through the states of New-York and New-Jersey, crowned by many sugar loaf eminences, that form a waving profile characteristic of primitive regions.

The average width of the Highlands in the State of New-York is twelve, and in New-Jersey, twenty miles. The general elevation is greater to the west, than to the east of the Hudson. The Fishkill is the most prominent and extensive of the Highland ranges to the east of the Hudson. Most of the mountains on that side of the river, viewed from Mount Dunderberg, in Rockland County, appeared considerably below me, and the summits like the broken waves of of a tempestuous ocean. The prospect from Mount Dunderberg is extensive and interesting. The Hudson is in view to the south for thirty miles. I overlooked the well-tilled region of Westchester county, and traced the towering greenstone range which forms the western border of the river. The secondary country between this narrow ridge, Haverstraw bay, and the Highlands, resembled an extensive plain in a high state of cultivation. The position of towns, and lakes, and the course of streams, were distinctly marked on this map of nature. To the north, the Hudson contracted, appeared far below, like a canal in a deep ravine. Its course for several miles could be traced. Elevated mountains limit the prospect to the north-west. To the south-west the waving Highlands were seen extending as far as vision could reach. The greenstone ranges of the interior of New-Jersey, and the mountains of Staten Island, were scarcely distinguishable from clouds.

The continuity of the Highlands is interrupted in several places, by rivers, and clove passages. The sections to the south, have the local names of Peekskill, Dunderberg, Ramapough, Pompton, Stony brook, Rockaway, and Morristown mountains, other ridges situated in the north-western part and centre, are called Sterling, Longpond, Raffenberg, Greenpond and Copperas mountains. Farther to the South are observed, Schooley's mountain, and Musconnitunk ridge. In passing through New-Jersey the mountains expand, occupying a greater breadth, but are less elevated than in the region adjacent to the Hudson, where Newbeacon on the east side rises to the height of 1,585 feet above the river, Butter hill 1,529, Crowsnest 1,418, and Bare Mountain 1,350.

The Highland ranges are primitive, with the exception of an insulated transition region of considerable extent situated in New-Jersey.

The ridges and heights almost uniformly display on their surface, masses of rock that will ever render them of little service to man for cultivation, and continue the principal part of this chain in a state of nature.

Except the narrow district of Smith's clove, no valley of any extent is presented in the western Highlands before they pass into the state of New-York, when fertile and in some places wide intervals commence. The most extensive, situated in the middle region of the mountains, passes through the transition district, and may be traced with an almost unbroken continuity to the Delaware, running parallel with the mountains.

Minerals.

The Highland ridges bordering West-Chester and Rockland counties in the State of New-York, and the secondary region of New-Jersey, present rocks of pretty uniform character—they are in general coarse, well crystalized aggregates of quartz and feldspar, often embracing short, garnets, hornblend, and epidote, with little mica, and in many parts for a considerable extent none—these simple minerals variously combined and arranged, form granite, gneiss, and sienite. In the middle or interior ranges situated in New-York, granite often containing black mica is the predominant rock.

Gneiss was sometimes observed, but splitting badly is seldom quarried. Sienite is often seen in every part of the Highlands, and I have noticed in several instances in these mountains well characterized primitive greenstone.

In the transition section of the Highlands of New-Jersey, graywacke and graywacke slate are the most common rocks. The extensive ranges in Bergen and Morris counties, or Long pond, Raffenberg, and Green pond mountains, for miles, present stupendous mural precipices facing the east of a reddish brown graywacke, composed of red and white quartz, red and gray jasper and indurated clay, embraced in a base which has a slight argillaceous odour, but generally composed of fine grains of the above mentioned minerals. These rocks are stratified, inclining to the north-west at an angle of about forty degrees. They are scattered in abundance on the banks of the rapid Pequannock, from Newfoundland to Pompton. Graywacke in place is sometimes observed resting on sienite adjacent to the river Pequannock. The general course of the transition mountains, is from north-east to south-west; and the average width of the transition district, located between the primitive ranges is six miles, and the length between thirty and forty.

Sulphate of barytes, and phosphate of lime are found at Anthony's nose, a mountain situated on the east side of the Hudson. Calc spar and asbestos are frequently seen. There are several extensive beds of iron ore in the Highlands of New-York and New-Jersey. This ore is the magnetic oxide, and is frequently granular. The most considerable of these mines is worked four miles west of the Hudson, in the Pompton mountains, near Rockaway, and at Succasunna. The inexhaustible beds of ore at this last mentioned place, the property of Governour Dickinson, produce the best iron manufactured from Highland ore—native magnet is found near Ramapough works, at Succasunna, and at Schooley's mountain.

Sulphuret of iron abounds in various parts of the Highlands. The most extensive bed I have observed is situated in Morris County, near the eastern base of copperas mountain, and nearly opposite to Greenpond. Copperas was manufactured at this place during the last war with Great-Britain by the following process. A minute division was made of the ore by grinding in a trough mill. It was

then spread upon a well-jointed inclined platform of wood, and exposed to the action of air, sun, and moisture—the sulphuret was changed to a sulphate of iron or copperas, by receiving additional oxygen, and the salt conveyed in solution to boilers by passing water over the bed.

Many rich beds of iron ore situated in the Highlands, are rendered useless for the forge by sulphur. It is said this might be remedied by roasting with a moderate heat, pulverising, and then placing the ore in water for some months. Graphite, or black lead, both foliated and compact is found at Mount Dunderberg, and is observed at various places, adjacent to the turnpike which crosses the mountains from Colvill's landing to Smith's clove, and epidote, talc, and adularia in the same neighbourhood.

At Munro iron works, situated upon the river Ramapough large plates of black mica crystallized in hexaedral form are seen, sometimes a foot in diameter—compact feldspar and epidote are noticed in the elevated primitive Highland ranges, west of the transition district—gray compact limestone is observed at Smith's clove, and at various parts of the New-Jersey transition interval. In the primitive range, situated in Morris County, west of Pompton plains called Stonybrook mountains, chlorite slate is common—granular limestone has recently been found in the same mountains. Its colour is a clear white, and it admits of a good polish. It is close grained and a nearly pure carbonate of lime, approaching the character of statuary marble. These beds may be regarded as a continuation of the range of granular limestone which accompanies with few interruptions the siliceous primitive from Canada to Virginia. From Stonybrook mountains I have specimens of noble serpentine of a bright green colour, admitting of a good polish. It is often associated with beautiful amianthus and talc, alternating in narrow veins. In the same vicinity is found a grayish white marble, rendered porphyritic by embracing numerous grains of noble serpentine, pretty equally disseminating through the rock. It is hard, and admits of a good polish. In the talc were observed metallic crystals, supposed to be chromate of iron. From this last mentioned mineral is extracted an acid which united with lead, forms patent yellow, or chromate of lead, a valuable pigment. Maryland is the only locality for chromate of iron in useful quantity hitherto

found. Galena has been seen in the graywacke ranges adjacent to Greenpond. Beautiful tremolite is connected with the white granular limestone of Stonybrook. The red oxide of zinc is abundant in the Highlands of Morris County within a few miles of Sparta, it is associated with granular iron ore. It is likewise found in several iron mines situated in Sussex County. As pure zinc can easily be extracted from the red oxide ore so plentifully observed, it is a matter of surprise that no attempts have been made to furnish that very useful metal to the public from the New-Jersey mines. Sulphuret of zinc is found near Hamburg and Sparta—crystals of quartz are frequently noticed in the rocks of the interior Highland ranges.

To the north-west the Highlands are bordered for their whole extent by a transition region which presents graywack slate, and blue compact limestone to the vicinity of New-Jersey.

In the transition of that state west of the Highlands, crystallized aluminated, white limestone abounds. It ranges through Sussex and a part of Orange County, embracing graphite, talc, zircon, and brucite. A rock in the vicinity of Sparta was formerly the only known locality for the last mentioned mineral. I have recently found it half a mile from that spot and Col. Gibbs has discovered it in quantity several miles distant. Dr. Torrey has observed it in specimens of white limestone from Orange County, and has recently been informed in a communication from Sweden, that a mineral of that kingdom is considered by Professor Berzelius the same as the brucite and called chondrodit, regarding it as a new species. The colour of brucite is a bright yellow, with a resinous lustre, found in crystals seldom perfect, and in amorphous masses three inches in diameter. In the limestone embracing this mineral, mica and foliated graphite are observed. I found at Sparta, masses of this last mineral, of several pounds weight. Compact gray limestone is seen in many places between Hamburg and Sparta near the base of the mountains resting on primitive rock. I noticed in this neighbourhood, petrifications of orthocerites, pectinites, madrepores and other marine, organic remains, generally in an argillaceous base. The most western ridge of the Highlands rises to a greater height than the other ranges of New-Jersey. An interesting view is

presented from its summit, of a rich, well-cultivated limestone valley fourteen miles in width situated in Orange and Sussex Counties. The soil is well adapted for wheat, which is abundantly raised. Beyond this interval the Shuongunck mountain is seen in connection with the blue ridge ranging the western horizon for fifty miles.

Animals.

The wild beasts of the forest, though not so numerous as formerly, are found in most parts of the Highlands. Wolves at times have been very troublesome to the farmers of New-York and New-Jersey. The wolves of America are less ferocious than those of Europe. Travelling in the Pyrenees, Alps, and Appenines, is often rendered dangerous by these animals. The wolves of our country are put to flight by the presence of man. When taken in a pit or trap, they become submissive attempting no defence. Bears are more common than wolves in the Highlands and mountainous regions of this country. Excepting when they have cubs or are wounded, they have rarely been known to attack the human race. They are very tenacious of life. Bears subsist principally on vegetable food. The lynx and wild cat are common in the Highland forests. Deer are frequently seen in the New-York section of the Highlands, but are far more numerous in New-Jersey. Foxes, rabbits, raccoons, and opossums are plenty, otters are often killed in the mountain waters. The wild cat is a powerful, active, and destructive animal, fearlessly invading settlements, carrying away the lesser domestic animals.

The poisonous reptiles most common are the rattlesnake and copperhead. Rattlesnakes are numerous in the transition mountains of New-Jersey. They find convenient dens in the masses of graywacke at the base of the mural precipices. A farmer residing in Newfoundland valley in the vicinity of Mount Raffenberg, informed me that he seldom killed near his house, fewer than twenty rattlesnakes in a season. Rattlesnakes if unmolested, rarely attack a passing traveller. The copperhead is more spiteful, and its bite equally dangerous. The poison of snakes taken internally, is harmless. Venomous serpents are known by their fangs or sickle-shaped hollow teeth, through which a deadly fluid

is ejected. Neither length of time, nor boiling will divest an extracted fang of its venom. The poison of snakes is more active and dangerous in warm, than in cold climates. The flesh of the rattlesnake is regarded in some parts of our country by epicures as a delicious dish. It has been asserted by respectable naturalists, that rattlesnakes and copperheads are the only venomous serpents of the northern states, and that our impression of the poisonous character of the adder and viper is derived from a misnomer of American snakes—but I have the most authentic testimony of the deadly effects of the bite of Highland adders. That they have fangs has been observed by well informed zoologists.

Vegetable productions.

The Highland ridges are mostly in a state of nature. To the east of the Hudson between the Fishkill and next Highland range, a considerable district of cleared and cultivated land appears. Adjacent to Hudson's bank almost every accessible part has been stripped of its heavy timber, but situations more remote exhibit thick forests of large trees on the rock bound surface.

Oak, walnut, beach, birch, ash, elm, sugar maple, is the predominant timber. Pine, hemlock and cedar is scattered through the forest adjacent to lakes and streams—on the high points of ground, walnut and oak, are the most common trees. Shrub oak is frequently seen in the transition Highland district which passes through Morris's County. It occupies almost exclusively an extensive level interval situated in the north part of Succasunna plain, it attains the height of six or eight feet, forming an entangled thicket. The ground below is covered by numerous loose stones. I travelled a considerable distance in narrow avenues cut through this diminutive wood.

Lakes and rivers.

In the State of New-York, west of the Hudson, the Highlands present several lakes from four to six miles in circumference, but the largest are observed in the centre or transition part of the range which passes through New-Jer-

sey. The most northern, called Long pond, situated on the confines of the State of New-York, is about sixteen miles in circumference. Moccasin pond occupies a less extent, but greater elevation of ground, and is supposed to be six hundred feet above the waters of an adjacent mountain valley. Green pond, situated to the south of the Hamburg turnpike and near the valley of Newfoundland, is a beautiful sheet of water about eight miles in circumference. It is bounded on the east by the wood-clad copperas mountain—to the west, forest-crowned, elevated mineral precipices of graywacke, frown over its waters. Two or three farm houses are pleasantly situated on its northern bank, where a fine sand beach is presented. This lake being well stored with fish, is a favourite place of resort for the fishermen of Morris and Bergen Counties. Several of the lakes formed in the transition region present on their borders, extensive and lofty walls of graywacke, and equal in romantic scenery, the celebrated waters of Cumberland and Westmoreland.

Numerous streams originating in mountain lakes, break through the ridges, wind rapidly down the Highland glens, and become auxiliary to the Passaic. The first and most considerable of these streams west of the Hudson, is the Ramapough. It takes its rise in the Highlands not far from the Hudson, passes the Munro and Ramapough iron works, and joins Pompton river, after ranging many miles, dividing the primitive from the secondary of Bergen County. The next is Long pond river, having its origin in the lake of that name. It connects itself with Pompton river. Farther south is the rapid Pequannock, which after coursing thirty miles in the mountains, enters Pompton plain, and uniting its waters with Long pond and Ramapough rivers, forms the Pompton. The Hamburg turnpike for sixteen miles, runs near the Pequannock, and presents much romantic scenery.

The river Rockaway has its source in Green pond lake, and joins the Passaic in the alluvial valley above the little falls. These streams present numerous mill-seats, many of them occupied by manufactories of iron. Except in the vicinity of turnpikes, at small manufacturing villages, and in a few mountain valleys, the Highlands exhibit a thinly scattered, ignorant and indolent population. In many parts but little removed from a state of nature, subsisting by a little farming, hunting, fishing, and the sale of lumber.

ART VI.—*On certain Rocks supposed to move without any apparent cause.*

REMARKS.

We have hesitated as to the admission of this piece, because a *name* may always be reasonably required when extraordinary things are related. On enquiry however, we find that the belief stated to exist by our anonymous correspondent, is actually entertained in the vicinity, and therefore we have concluded to let the thing take its chance with the public, without in any way committing ourselves as to the truth of the opinion entertained.—*Editor.*

TO PROFESSOR SILLIMAN.

WILLIAMSTOWN, Feb. 10, 1822.

Sir,

As I was lately travelling through the State of Connecticut, my attention was excited by a curious, and to me a novel phenomenon. In passing through the town of Salisbury, I was informed that in a certain pond, in the north-east part of the town, there were a number of rocks continually, though gradually, moving towards the shore. At first I concluded that this was like one of those stories of the marvellous, which are circulated in almost every place, and springing from some unknown source, gain some addition from every narrator, till at length they become "strange—passing strange."

I was not unacquainted with the dancing bogs and falling mountains of Hibernia, but never before had I heard of rocks, on level ground, taking up a gradual line of march, and overcoming every obstacle in the sublime effort of escaping the dominion of Neptune. Perhaps there are numerous cases like this—if so, they have not as yet come under my observation. Determined to learn the truth, I visited the place, accompanied by a gentleman who resides in the vicinity.

Included you will find a sketch* of the situation of the lakes, road, &c.; and though in some small particulars

*See the plate at the end of this No.

it may be deficient or inaccurate, yet as a whole it will give you a tolerably correct idea of their relative position. C, the road; F, canal uniting the ponds; B, a low marshy swamp; D, an orchard on higher ground; A, moving rocks. From careful observation I am convinced that the lakes were formerly one. The low ground marked B is evidently alluvial. It lies almost on a level with the surface of the water, and shells are invariably found in digging a few inches. The soil is a black mould, covered with willows, and a growth of ash of forty years standing. Indeed, the proof is so satisfactory, that this was once covered with water, that any one, who visits the spot, cannot doubt for a moment. The next thing which I would notice, is the narrow isthmus, through which the road passes, leading from the east to the west part of the town. The road itself is a natural elevation of some feet above the adjacent low ground, of convenient width, and formed of limestone rocks, evidently not in place, and apparently thrown carelessly together. To the question, how this extensive elevation was formed, I can give but one answer. From some cause unknown, they have moved from the lake and taken this position. My reasons for this conclusion are the following:—First, all the stones in that part of the lake, adjacent, are constantly moving in that direction. Second, no similar collection of detached rocks can be found, except in the vicinity of higher ledges, or such as are artificial. This is a highly primitive country, and much abounding in carbonate of lime. The strata of limestone, which extend from Vermont through Berkshire, to Connecticut, and afford such excellent marble, run through this town, and stretch towards the Atlantic. This, it is well known, is always found in quarries of considerable extent, and never scattered over the surface of the earth, except in the cases above mentioned, or in the vicinity of rivers. Where there are lofty ridges of it, exposed to the action of the elements for a series of ages, we naturally expect to find detached masses* scattered round. But here the country adjacent is level, and, within the com-

*I fear there are many facts which cannot be accounted for by any of the existing theories. Of the two popular theories, how can the fact that some of the densest and heaviest of the minerals lie near the surface, be made consistent with the one, or the order observable in the position of the different strata with the other?

pass of nearly a mile, no such eminences appear. But I shall perhaps throw some light upon this, when I come to those rocks which move. The third argument which might be adduced, is the situation of the rocks. This neck of land (I mean that part of it which is not alluvial,) is nearly of the same width throughout. Were not some of the rocks of which it is composed, of such a size, we should undoubtedly be led to suppose it an artificial causeway. Does not this equality, or uniformity of width, favor my supposition?

As to the moving rocks, I made such observations as my short stay in the place would permit. This phenomenon was known to the first inhabitants of the town. Its probability was suggested by their own observation, and its truth established by actual measurements. From the gentleman with whom I visited the spot, I obtained the following measurement. Its correctness may be implicitly relied on.

Sept. 1819. The distance from the largest rock to a certain birch tree on the shore, was 15 rods 39 links.

Feb. 13, 1821. The distance of the same rock to the same tree, was 12 rods 37½ links. Subtracting 12—37 from 15—39, leaves 3 rods 2 links, which this rock moved in less than eighteen months. The same gentleman measured it each time, and used the same chain in both.

Twelve* years ago it moved but five feet in a year. Its motion is therefore accelerated as it approaches the shore. I have spoken particularly of this rock, because it is the only one whose exact progress has been ascertained. All the stones however, in this part of the lake, move, from the largest to the smallest, and leave a track or trench behind them, of greater or less magnitude, in proportion to the size of the stone. The largest rock (and it probably weighs forty or fifty tons,) has ploughed up the sand and gravel before it

*The island marked E is about three quarters of a mile from the shore. It is composed of mica slate, lying on a bed of limestone; large masses of the latter lie on the shore of the island. You will see by a simple calculation, that, at the present rate of moving, they will reach the opposite shore in less than a hundred years. That those masses composing the foundation of the road came from thence, I will not pretend to say.

The minerals I observed in Salisbury are the following:—Tremolite radiated, stellated with fibres nearly two feet long; Garnets in abundance; Staurotide; black and white Mica; Jasper; Sulphat of Iron; Alumine; Iron ore—all varieties; generally the brown Iron stone of Werner; Dolomite; Carbonate of Lime; Mica slate; Clay; Ochres, &c. of various kinds. Some Copper, in the Iron-ore lately found.

nearly above the surface, while on the other side the water is three or four feet deep.

Forty years ago, I am informed, this rock was entirely covered with water; now it projects some feet. Several other facts could be adduced to prove the motion of these rocks, but I consider it unnecessary. Universal belief of a phenomenon so uncommon, is of itself sufficient in my mind to establish it.

Respecting the causes of this phenomenon, none, which are at all satisfactory, have as yet been suggested. Some pretend that it is effected by the agency of ice. We very well know the great expansive power of ice; but how it can move some rocks, and not others, and even some which it does not touch, we are yet to be informed. Accurate observations, to find in what part of the year they move most, would probably afford some assistance to the enquirer. That such observations be made, is highly important, and earnestly desired.

Such, sir, are the results of my investigation. Should you esteem them worthy a place in your Journal, they are at your disposal.

Yours, &c.

PETROS.

A FRAGMENT—PUTNAM'S ROCK.

Extract of a letter from Prof. Dana of Dartmouth College, to the editor, dated Feb. 5, 1822.

I HAVE received an account of "*Putnam's Rock*," which is in the river opposite West-Point. It was given to me by my friend Col. Tucker, of Gloucester, Mass. and the history, as connected with the American Revolution, cannot fail to be interesting; I will give it in the Colonel's own words, as there is a naïveté in his manner of relating it.

"This famous rock, originally a native of the highlands above West-Point, was situated on the extreme height of *Butter-Hill*;† when the morning fog was descending from the hill, it had a very beautiful appearance, not much unlike a horseman's tent or hospital marquee riding on the cloud. It was a common amusement for the officers when off duty

†This hill is 1520 feet above tide water, and 1332 above its base, according to Capt. Partridge.—*J. F. D.*

to roll large rocks from the sides of those hills. These often set others going with them, to the great terror of those persons who were below. One day when this laborious amusement was over, Col. Rufus Putnam (in whose regiment I served as Lieutenant,) proposed going up to take a peep of this curiously situated rock; it was found situated on a flat rock of great extent, and near the brink of a considerable precipice, and hung very much over it. Col. P. believed that it was moveable, and if once moved would roll over; and, falling from 20 to 50 feet, commence its route to the river. A few days after we formed a party of officers, with our servants, who took with them axes, drag-ropes, &c. in order to procure levers for the purpose of moving the rock, which we soon found was in our power. The levers being fixed with ropes to the ends of them all, Col. Putnam, who headed the party, ordered us to haul the ropes tight, and at the word *Congress* to give a long pull, a strong pull, and a pull altogether. This we did; the levers fell, the rock rolled over, tumbled from the precipice, and took up its line of march for the river!! The party then had the satisfaction of seeing the most majestic oaks and loftiest pines bowing down in homage and obedience to this mighty traveller, which never stopped till it reached the bed of the river, where it now lies on the edge of the flats, and far enough from the shore for a coasting vessel to sail around it. The party followed after in its path, and were astonished to see that rocks of many tons weight, and trees of the largest size, were ground to powder; on arriving at the river the party embarked, and landed to the number of sixty or seventy on the rock, where Col. Putnam broke a bottle of whiskey, and named it "*Putnam's Rock*." I may have forgotten some of the minutiae of the transaction in the lapse of forty-three years, but it is a fact that the rock now in the river was removed from the extreme top of Butter-Hill, by the officers of Col. Rufus Putnam's regiment, in the Revolutionary war, in the service of the United States, sometime in the month of June, in the year 1778."

ART. VII.—*Miscellaneous notices in Mineralogy, and Geology.*—EDITOR.

1. *Snowy Gypsum* in extremely delicate crystalline scales, so minute as to be scarcely discernible by the naked eye—colour pure white, with here and there a slight tinge of grey; it might be wrought as an alabaster, and is more beautiful than any thing which we have seen, that was produced in this country. We received it from the Hon. John Calhoun, Secretary of War, to whom it was forwarded by Mr. Horton Howard, who writes from Delaware, Ohio, that it is found in a large body on the shore of the north side of Sandusky Bay. Mr. H. R. Fenn of Rochester, N. Y. has handed us a similar specimen from Rochester, L. Ontario, where it is found imbedded in fetid limestone.

2. *Nephrite*, so called by Dr. Mead. This beautiful mineral is of a lively apple green, like chrysoprase—it is almost impossible to break it, such is its excessive tenacity—its fracture is splintery—it is softer than the nephrite of the books, being scratched by steel. It occurs in large masses imbedded in white primitive lime-stone, which is almost compact—this mineral has not been analyzed and perhaps it may be doubted whether it is the genuine nephrite—we understand it is nearly exhausted—locality Smithfield near Providence—the specimens were from Mr. George T. Bowen of Providence.

3. *Compact magnetic oxid of Iron*, lustre highly resinous—colour brown—Owyhee, from the American missionaries in that Island.

4. *A vesicular lava*, like that of Hecla. It forms a prevailing rock in Owyhee.—Id.

5. *White statuary Marble*, North-West Coast of N. America.—Id.

6. *Native Copper* in rounded pieces—near the mouth of St. Peters river which empties into the Mississippi—this native copper is frequently covered with a coating of green oxid and is disseminated among limestone rocks. Rev. Dr. Morse and son.

7. *Carnelians and agates*, very well characterized.—Alluvial banks of the Mississippi, at Prairie du Chien.—Id.

8. *Quartz*, perfectly milk white—Sandusky bay, Ohio.—Id.

9. *Reddle*—a very fine quality. Indian Pipes made of this substance—Banks of lake Superiour.—Id.

10. *Sulphate of Strontian* in distinct tabular crystals of a light sky blue colour, three fourths of an inch in the largest diameter, lining a cavity in grey compact limestone which is its native bed—Gross Island, mouth of Detroit river.—Id.

11. *Fibrous Gypsum*—Martin Isles—four miles from Mackinaw, the vein is too inches thick and tolerably handsome.—Id.

12. *Red Ochreous earth*—Michigan territory.—Id.

13. *Galena*, a most beautiful specimen of the broad foliated variety, exactly like that of the Missouri mines—seven miles below the Ousconsin, on the east bank of the Mississippi. The mines belong to the Sacs and Foxes, who are said to be very jealous of their rights.—Id.

14. *Gypsum*, superb specimen folia broad and curved—Manlius, Onondago county, N. York, south bank of the great canal.—Id.

15. *Staurotide*, imbedded in mica slate—Alstead New-Hampshire—Mr. J. D. Bradley.

16. *Serpentine*, leek green with magnetic Iron imbedded—Cavendish, Vt.—Id.

17. *Asbestos*—very delicate—Mount Holly, Vermont.—Id.

18. *Macle* or *Chyasolite*.—This mineral occurs in Charleston—Cornish—Croydon—Alstead and Langdon, N. Hampshire—Bellows-falls and Westminster, Vermont.—Id.

Very dark grey Cyanite—Charleston, New-Hampshire, no greenish or bluish tinge.—Id.

19. *Mica* in large plates—Alstead, New-Hampshire.—Id.

20. *Green foliated Talc*, containing Actynolite. On page 54, Vol. 4, of this Journal mention was made of these minerals as occurring in Windham Vt. Since that notice was written, we have received very superb specimens equal to any from the best European localities. The largest crystals of Actynolite are half an inch in diameter, several inches long and of a rich green colour.—Id.

21. *Sulphat of Barytes* in limpid tabular crystals, occupying cavities in sand-stone—along with quartz crystals, malachite, common sulphat of Barytes, &c.—Cheshire, Connecticut.

22. *Ferruginous sand-stone*—it is a quartz in grains, cemented by brown oxid of iron of a resinous appearance—it is said to be a good material for a sub-marine cement. Virginia.—D. M. Randolph, Esq.

23. *Sand-stones* with organized remains.—Id.

24. *Lime-stone* with very large and distinct screw stones, as they are commonly called.—Id.

25. *Rutilite*, three miles from Philadelphia, Mr. Lea.

26. *Prim. white, carb. of lime*, twelve miles from do.—Id.

27. *Sulphat of Barytes* stained by carb. of copper, forty miles north of do.—Id.

28. *Granite* with handsome garnets, Wilmington, Delaware.—Id.

29. *Zeolite* three miles from Philadelphia.—Id.

30. *Sappar*, near do.—Id. *Pistazite* do.—Id.

31. *Sulphuret of Molybdena*, fifteen miles south of Philadelphia.—Id.

32. *Sulphat of Barytes* crystallized in tables.—Southington, Connecticut.

33. *Yellow blende*—galena and crystallized carbonate of lime, do.

34. *Quartz Geodes*—Berlin, Connecticut, in green-stone trap.

35. *Octahedral Iron*, large and distinct crystals—believed from Bridgeport, Conn.

36. *Galena Foliated*—very handsome—Livingston's mine N. Y.

37. *Novaculite*—the middle specimens good—the extreme verging towards mica slate—Island in Lake Memphremagog.—S. S. Conant, Troy.

38. *Iron ore*—fine grained, micaceous—very beautiful—Jamaica twenty miles west of Bellows-Falls—Dr. Allen.

39. *Staurotide*—crystals crossing at right angles—Southbury.

40. *Adularia*—nearly equal to that of the Alps—Brimfield, Mass.—Professor Eaton.

41. *Bitterspath*, beautifully crystalized with common crystallized calcareous spar and snowy gypsum, fibrous and foliated.—Shores of Lake Ontario.—Dr. Lyman Foot.

42. *Shot Ore*, Franklin near Sparta, New-Jersey. This ore is so called by the boys because they use it as a substitute for shot in firing at birds. It is found in company with

42 *Notice of the locality of Sulphate of Barytes, &c.*

the red oxide of zinc. It was analyzed in France by Berthier and found to consist of iron manganese and zinc. (See Vol. 2, p. 323 of this journal.)—Dr. Meade.

43. *Yellow blende*, very beautiful accompanying foliated carbonate of lime these substances reciprocally intermix with each other and form an elegant combination. It accompanies the *shot ore* mentioned above and the red oxide of zinc. Sparta, New-Jersey—Id.

44. *Vegetable Impressions* of ferns and other plants remarkably distinct in transition slate, Providence, R. Island—Mr. Geo. T. Bowen.

ART. VIII.—*Notice of the locality of Sulphate of Barytes, from which a specimen was analysed by Mr. G. T. Bowen; (See p. 325 Vol. IV. of this Journal,) and of various other mineral localities in Berlin Conn.; by Dr. JAS. G. PERCIVAL.*

TO PROFESSOR SILLIMAN.

Sir,

The specimens of Sulphate of Barytes analysed by Mr. G. T. Bowen were found in Berlin, about half a mile west of Kensington meeting-house, in a vein in a ridge of green stone. The immediate vicinity furnishes several very interesting minerals. The township is part of the red sand-stone formation extending from New-Haven through Connecticut and Massachusetts to Northfield. The rock is there schistose, generally soft and argillaceous; sometimes the folia are very thin and brittle. This rock in many places is overlaid by green-stone. On the west and south sides of the town is a range of trap mountains; the sand-stone rock, where it first comes out from below the trap in Southington and Cheshire, is changed, and approaches to conglomerate. I do not recollect an instance of that form of sand-stone in Berlin; in three points in B. (see the map,) the schist is converted into shale more or less bituminous. The green-stone lies in ridges rather narrow, running quite directly north by east, Sometimes the sand-stone can be very distinctly seen cropping out below the green-stone on the west side of the ridge.

es. In other ridges I have not found any sand-stone below the green-stone, which there seems sunk, as if in a trench, below the general level. I have designed this article as a brief notice of the locality of the Sulphate of Barytes; I shall therefore dismiss more general observations. The sulphate is found in a vein, perhaps two or three feet wide, in a ridge of green-stone. I have subjoined a rude outline of the vicinity. The ridge of green-stone in which this vein is situated, sinks on its eastern side below the general level, and is fronted by a wall of sand-stone at the distance of three or four rods. It contains three interesting localities. (A) the Barytes vein; (C) the coal-mine, and (D) the leadmine — (A) the vein of Barytes. This is in the bed of a brook, where it passes in a deep ravine through the green-stone ridge, directly below a mill-dam. The ravine is divided by two masses of rock, so that there are three dams. The north turns a grist-mill; the middle an oil-mill; and the south a saw-mill. At the bottom of the ravine the three channels unite, and pass under two bridges almost contiguous. The vein appears first in the bed of the south channel, just below the saw-mill; it is there traceable north by east about a rod. It is again discoverable about four rods north, in the bed of the stream below the upper bridge. Both of these points are on the same line. The vein is two or three feet wide; its surface is iron brown, and tarnished; but on breaking it, it appears of an opaque pearly white. It is foliated, and breaks into rhomboidal fragments; it is very brittle, which renders it very difficult to detach it in large masses; it often assumes on its surface the appearance of coxcomb spar. I have found fragments of it in the brook below, imbedding crystals of Galena. Parallel with it, and separated by a narrow partition of green-stone, is a thin vein of carbonate of lime foliated, and transparent in fragments. The hyaline appearance of the carbonate easily distinguishes it from the pearly hue of the sulphate. The eastern wall of the ravine projects over, and forms a recess near the upper point of the vein; the ceiling of this recess is covered with minute effervescing stalactites. Directly south of the vein the green-stone rock has been torn away, and its fragments are full of geodes of quartz crystals, often taking the form of hollow cylinders lined with crystals. A little farther south is a large rolled rock

44 *Notice of the locality of Sulphate of Barytes, &c.*

of granite; on the surface, (C) the coal-mine. This has been opened on either side of the brook, where it passes through a narrow ridge of green-stone. The coal has been found only in the green-stone. Directly fronting this rock, on the east, is a wall of sand-stone slate, at the base of which the brook runs. The coal was first found, and wrought, in the bed of the brook, about twenty years ago; about six years ago, a company in New-York made new openings in either bank of the brook. The coal is found in veins in connection with crystallized quartz; the quartz often appears in geodes whose cavities are filled with coal; narrow veins have their walls lined with crystallized plates of quartz, and are filled with coal; the coal has never been found in large masses: the largest that I have seen not more than two or three pounds. The larger masses are foliated, shining, brittle, and very bituminous; but it more usually has the appearance of cinders so mixed up with silicious matter as to be hardly combustible. The sand-stone in its vicinity I have not observed to be converted into shale. On the eastern face of the green-stone ridge, forty rods north of (C), on the west bank of the brook, is (D) the lead-mine. This was first opened during the revolutionary war, and again about fifteen years ago. Several of the old pits and heaps of rubbish remain; the veins are found in a north by east direction; the minerals I have found in the rubbish are galena, in small cubical crystals, foliated, and finely granular; the crystals which are exposed to the air are often covered with a thin pulverulent coat, or they are beautifully iridescent. Blende yellow and black, the latter rare; it is in much larger masses than the galena. Pyrites; this is the rarest of the three sulphurets; the gangue is sulphate of barytes, resembling that of the former vein—often resembling coxcomb spar. Carbonate of lime; colourless and crystallized, or foliated; agatized, i. e. in layers of different colours and textures, foliated, granular, and fibrous. The fibrous layers are generally external, thin, with the fibres perpendicular to the direction of the layers. Quartz in geodes and crystallized plates, (a fine-grained green mineral, resembling disintegrated green-stone?*) On the eastern face of the green-stone ridge, between (C) and (D,) the rock is

* Chlorite?—this is found in similar circumstances in the green-stone near New-Haven.—*Ed.*

speckled with minute cavities, occupied by chalcedonies, agates, and quartz crystals. The valley of the brook is there filled with pebbles, in which I have found blue and white agates, and abundance of quartz crystals; some nearly perfect, one an inch long, with the prism and two pyramids, and some slightly tinged with amethyst. This valley is bounded easterly by a sand-stone ridge, on the top of which stands the Meeting-house; about half a mile south of the M. house, in the bed of a ravine, is a bed of shale, (F) which gives by friction a strong sulphureous smell. Directly east of this sand-stone ridge, is a ridge of green-stone, based on sand-stone; on its western face, half a mile north of the road, is an interesting display of different sand-stone strata; (G) the upper are not schistose, but compact and soft, more or less tinged with purple; the green-stone in breaking often turns out nodules, which are richly iridescent on their surface. I think them strongly impregnated with iron, and this is communicated to the sand-stone or indurated clay. Beneath these strata is a stratum of free-stone, of excellent quality (real sand-stone;) the rock then becomes more schistose, and the lower strata are in thin layers, and very brittle—breaking into minute fragments. Where the road ascends the east face of this ridge, (E) the green-stone is fragile, breaking into fragments of which the road is formed. The fragments are porous like slag or lava; on penetrating into the rock these cavities are found occupied by zeolites, or lined with minute chlorite crystals. The zeolites are of two varieties; foliated fibrous and radiated; on exposure to air they become opaque white, pulverulent, and are finally dissipated; leaving the rock porous. This, I presume, is owing to the same decomposition which converts the coarse grained granite of veins in gneiss into kaolin, of which I have seen striking examples on the Schuylkill, near Philadelphia. East of this latter ridge is an extensive flat of alluvial formation, where several streams centre from the surrounding hills and mountains.

Yours, &c.

JAMES G. PERCIVAL.

ZOOLOGY.

[Communicated for insertion in this Journal.]

ART. IX.—*A group of Polypes, belonging to the family of Comatula, with an extraordinary form and configuration from the Indian Seas.*

[Specimen presented and description read to the New-York, Lyceum of Natural History, at its sitting in the Institution, on Monday, Feb. 25, 1822.]

Gentlemen,

My friend Mr. Covert, on a voyage from Canton to New-York, during 1821, cast anchor with eighteen fathoms of line (one hundred and eight feet) in the straits of Gaspar, situated to the eastward of the island of Banca.

On hauling up the deep-sea-lead, two marine productions which adhered, were brought on board the ship; one attached to the weight below, and the other clinging to the cord about ten feet from the bottom, or above the lead.

Both the specimens were brought home in good condition, and presented to me. Though they seem to be individuals of the same species, it was observed that when they were taken out of water, one of them appeared for a while yellow, and the other blue. This was probably, while the polypes were living, for after death, the colour became a purplish brown, or of the hue belonging to many of the gorgonias.

According to the modern classification, this singular and elegant production, belongs to that tribe of the polypes which makes floating or moveable habitations.

The Comatulas are the most remarkable members of this family. They have a calcarious or corneous axis. They are not located in a spot, or fixed in a particular place, but move or swim about.

The one now presented, instead of a *single feather*, as usual, consists of *ten branches*, proceeding from a common base or centre, and diverging outwards with an easy slope, makes a display like a coronet of plumes. Each is about

eight inches long, and tapers gradually upward. The fringe-like appendage is on the inside, forming a row of offsets, about half an inch in length. The feathers articulated from the bottom to the top, are composed of parallel circles or rings.

From the receptacle or point, where the receptacle exists, at which all the plumes unite, or from which they issue, a set of arms or feelers proceed or project in an opposite direction. These arms or feelers have some resemblance to the antennæ of lobsters; though from their disposition to clasp the things which come into contact with them, they resemble the tendrils of plants. They are nearly of the size of small crow-quills; and vary from half an inch to an inch in length. They are articulated and coloured like the plumes. They are twenty in number; and the extremity of each is armed with a claw like that of a bird or of a cat. Several of the joints or articulations, near this terminal claw are also armed on the inner side, with claws of a like organization, but of a smaller make. The arms or feelers, undoubtedly possess the power of expansion or groping, and of seizing or embracing any object they may find. In one of the individuals I possess, a five rayed *asterias*, is firmly held, and indissolubly bound, by the embrace of the Comatula.

This production of the Indian ocean, connects the *polypes* and *radiaries* with the *sepias*, and all of them with the *ten-footed crustaceas*,

Truly, and as ever, respectfully yours,

SAMUEL L. MITCHILL.

BOTANY.

ART. X.—*Attempt* of a Monography of the Linnean Genus Viola, comprising all the Species hitherto observed in North-America; by LEWIS D. DE SCHWEINITZ, of Salem,† North-Carolina.*

[Communicated for this Journal.]

PRELIMINARY OBSERVATIONS.

THE accession to the Flora of North-America, by the united efforts of the growing number of able Botanists, is becoming such, that a necessity begins to be sensibly felt of reviewing and comparing their labors, in order to avoid that confusion of synonymy, which must otherwise inevitably ensue. It is of great importance, more especially in those genera which comprise numerous species, and the annexed disquisition has for its main object, such a comparative review of one of these. The Genus *Viola*, constituting no contemptible, though no very brilliant contribution towards Flora's vernal wreath among us, evidently labors at present under considerable confusion of its numerous species, and their varieties; which is increased by the uncommon degree of variability apparent, even among the individuals of the same species. An attempt to define and establish these, and to point out such characters for each as may facilitate discrimination, is therefore peculiarly necessary; and my vicinity affording favorable opportunities of observing the greater part in their native places, while my collection contains excellent specimens of almost all the rest, I have bestowed a good deal of attention upon the Genus. I flatter myself, that the results of my study and observations, here communicated, may contribute towards a better discrimination of the American species of *Viola*, and thus prove acceptable to Botanists.

As far as my means have enabled me, I have endeavored to determine the synonymy of the species hitherto descri-

*Received July 28, 1821.

†Now (April 1822,) of Bethlehem, Penn.

bed by authors. But in the execution of this plan, I found myself under the imperious necessity of proposing several new species, as a means of extricating some of those hitherto received, from the attending difficulties. It has been my endeavour not to do so upon slight grounds, but on the contrary to satisfy myself by reiterated observations, in most instances continued for several years, of the constancy of the characters, I have selected. The ample descriptions I have given of all, I had an opportunity of studying, in a fresh state, will enable Botanists to test the accuracy of my discriminations.

The generic description of the genus given by Mr. Nuttall (p. 147, Vol. I.) is so satisfactory, that it is needless to repeat it. His observation concerning the apetalous flowers of all our species, I entirely accord with, although they appear not so regularly in the Caulescent family, as in the first; and it is impossible not to coincide with him as to the anomalous *V. concolor*, which evidently, together perhaps with some tropical species, ought to be generically separated from the rest. All the other American species form, with those indigenous to northern Europe, (the greater part of which are in my collection,) a most excellent natural genus. There is however no single European species that can with propriety be considered identical with any of ours, unless it be the *V. bicolor* and even this differs so much, that I cannot think them the same; indeed, it is rather remarkable that no European *Viola*, except very partially the *V. odorata*, appears to have become naturalized in America, not even the *tricolor*, so extremely common in Europe in fields of grain.

The American species, like those of Europe, form two very handsomely distinguished groups or families; the first altogether *Stemless* (acaules,) and the other *producing stems* (caulescentes.) With us the number of species in each is nearly equal. The first group contains only four European species—the last from 16 to 17; a considerable proportion of which are alpine, and belong to the subdivision, *Stipulis pinnatifidis*, of which we have but one. I presume some more, and perhaps new ones might be found in our highest northern mountains, or in Labrador.

Genus *Viola*.

Classis V. Pentandria. Ord. I. Monogynia.

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A. *Violae acaules* ; Stemless *Violae*.

Species of Europe, belonging to this family :

1. *V. pinnata*. 2. *V. hirta*. 3. *V. palustris*. 4. *V. odorata*.1. Species. *V. pedata*. Linn.*Willdenow*, Spec. p. 1160, n. 2.*Persoon* Synopsis, p. 254, n. 2.*Michaux* Fl. p. 151,*Pursch* Fl. l. p. 171, n. 1.*Nuttall* Gen. p. 147, n. 1.*Elliot* p. 300, n. 10.*Waller* p. 219.*Muhl.* Cat. p. 28, n. 2, by specimens.*New-York* Cat. p. 28, n. 2.*Viola digitata* Pursch p. 171. belongs to this species; and is the advanced state thereof.

V. acaulis. *Folius* ime pedato-multipartitis (septem-partitis,) glabriusculis, margine saepe ciliatis, aetate provectiori rugosis, venosis. *Laciniis* lineari-lanceolatis; in foliis primariis integris aut subdentatis, magisque rotundatis; in secundariis elongatis, acutioribus, et fere semper tridentatis. *Petiolis* primum brevioribus scapis, demum elongatis, longis, sensim in folia expansis, vel potius foliis in petiolos angusto margine decurrentibus. *Stipulis* radicalibus, albis, membranaceis, basi latis, in longum acumen productis, marginibus dense ciliatis, ciliis longis flexuosis.

Floribus maximis, habitu applanato, coeruleis. *Primariis* breviter pedunculatis; secundariis, in scapis longis, folia tamen non excedentibus. *Petalis* nullis barbatis; inferiori latissimo, superioribus ovatis, omn. rotundatis. *Calyctis* laciniis lanceolatis acutis, margine colorato, ciliato, ceterum glabris; postice productis truncatis. *Stigmate* maximo, compresso, angulato; apice oblique truncato, perforato; cum antheris valde prominente.

Scapis angulosis, demum longis, glabris. *Stipulis* binis, ad basin scapi, oppositis, linearibus, adpressis, longis, flexuosis, breviter ciliosis aut integris.

Capsula glabra, stigmate persistente coronata.

Radice crassa perpendiculari, frequenter emittente radículas longissimas.

This elegant species, seems to be recognized by all Botanists. The only one any way nearly related, is the alpine species of Europe, *V. pinnata*; the leaves of which are however much more numerously and less deeply divided, and the divisions obtuse. The divisions of ours, are called *sempartite* by authors, and this in fact is the common number, but by no means constant. Mr. Elliot truly observes, that the leaves afford a fine exemplification of a

pedate leaf, especially the early leaves. I am perfectly satisfied, that the *V. digitata* of Pursch, found by Mr. Leconte in Virginia, must be considered identical with *pedata*, having seen innumerable individuals of the latter assume a form as the season advances, altogether answering the description of *digitata*; some indeed, with the first leaves still remaining upon the plant. Later in summer and autumn, I have occasionally met with specimens forming very large tufts, with leaves extremely rugose and veiny, on petioles five or six inches high, expanding into the leaf, and uncommonly large pale blue flowers. The *pedata* begins to flower, with us, end of March, and is very common in dry woods throughout April. I never found it in moist places, and Mr. Elliot observes that it rarely occurs within sixty miles of the sea-coast. Northwardly it appears in May. The beautiful variety, mentioned by Pursch, having the two upper petals of a dark purple and velvet appearance, is common here and elsewhere, *β. velutina*. It is more slender in all its parts, and forms but small tufts, often with a single flower and a much longer scape.

2. Spec. *V. palmata*. Linn.

Remarks.—This species, and the next, appear to have been confounded by most Botanists. In fact it is not easy to fix upon proper diagnostic characters between them, without an attentive study, in their different stages of growth. They and others, of this family, put forth leaves of very different shapes, not only at the same time, but successively, so that the same individual plant might readily be mistaken for a different species, when more advanced; especially as they continue to flower, during the whole course of these metamorphoses, ending with apetalous flowers. By close observation of the same individuals, continued to the last stage, I conceive myself able to point out such constant characteristics, as may serve to distinguish each species at all times.

I have to observe generally, with regard to the disposition of the leaves, in all the heterophyllous species of *Viola* acaules, that the more entire leaves, whether cordate, reniform or lanceolate, are always the outward ones of the tuft, the lobed ones, the interior. The entire ones, are moreover on much shorter petioles. The lobed leaves too, except in *palmata*, where they appear immediately, are generally of later growth and augment in number and vari-

ety of shape, as the plant advances. After inflorescence, the leaves of most of these, and indeed generally, throughout this family, seem to expand and grow very vigorously, often attaining a size and appearance, altogether unusual with them, while in a flowering state.

It cannot be expected, that I should have perfectly succeeded in referring the confused Synonymy to my species, as established below. I have therefore accompanied my citations to *palmata* with remarks, pointing out my ideas more particularly.

Willdenow Spec. p. 1159 n. 1. I conceive, from the expressions used, that this, together with all the citations, ought to be exclusively referred to *palmata*. *Pluk.* expressions are peculiarly appropriate.

Persoon Synops. p. 254. n. 1. may well allude, both to *palmata* and the next.

Michaux p. 151. evidently includes both.

Pursch p. 172. n. 3. Not definite enough to distinguish.

Nuttall p. 147. n. 2. Mr. N.'s observation concerning the resemblance to *V. cucullata* appears to have been occasioned by specimens belonging to the next species, not distinguished by him—otherwise, it is clear that he refers to my *palmata*.

Elliott p. 300. n. 9, exclusive of his variety d) *heterophylla*, is decidedly *palmata*. That variety may belong to a separate species.

Muhl. Cat. p. 25. n. 3. By specimens.

Walter See Elliott.

V. acaulis. Foliis *primariis* raris, cordatis, reniformibusque, plurimis, et *secundariis* omnibus, palmatis, lobis diversissimis, medio lobo semper majori; omnibus crenatis, dentatis, plerumque nervosis; plus minusve pubescentibus; interdum undique cano-pubescentibus, interdum glabriusculis, nervis tamen semper pubescentibus. Statu juniore, foliis perpaucis, demum frequentioribus. *Primariis* saepe convenientibus in stolone distante a scapo. Lobis foliorum palmatorum polymorphis, praesertim versus basin saepe multifidis, angustis; interdum etiam lyratis, et truncatis. *Petiolis* quasi canaliculatis, ob marginem decurrentem ex folio angustum; interdum glabris, saepe pilosis. *Stipulis* radicalibus magnis, lato lanceolatis, submarcidis et coloratis, margine subciliatis. *Folius* saepe subtus rubicundis et purascentibus.

Floribus majusculis, violascentibus et purpureis, contortis; petalis lateralibus maxime albo-barbatis, ceteris glabris; *inferiori* ovato, postice naviformi, manifestum carinato, antice rotundato, venis purpureis ornato; omnibus fundo albescentibus. *Calycis* laciniis ovato-lanceolatis, glabris, margine albescenti ciliato. *Stigmate* capitato, recurvo, rostrato, marginato, depresso. *Antheris* in fundo reconditis.

Scapis longitudine foliorum, interdum glaberrimis. *Stipulis* minutissimis, oppositis, in medio scapo, aut inferius sitis, linearibus, ciliatis.

Capsulis glabris, calyce brevioribus.

Radice obliqua crassiuscula, caespites pauci-foliosas efformante.

This is by far the most variable species, and consequently the most perplexing. Scarcely two individuals are perfectly alike, and I can hardly figure to myself any possible formation of palmately lobed leaves, which I have not met with. Every different situation, as to shade, soil and perhaps even weather, appears to alter the shape of the leaves, and I think it useless to attempt to reduce these ever varying forms to definite varieties, as they appear multiplied almost without end. The middle lobe is however constantly the largest; in some varieties it assumes a long lanceolate, in others a broad ovate shape, with every possible intermediate one. The lower segments or lobes towards the base again, are always the most diversified. In some they are broadly truncate, in others almost linear and elongate. The degrees of pubescence of leaves and petioles, between an incane villosity and almost smooth, are equally variable. The varieties occurring in rich shaded woodland, are particularly remarkable. One I have repeatedly met with, is exceeding tall and slender, pubescent in the petioles and scape, nearly smooth in the leaves, of which it generally has one cordate, one reniform and one very regularly five lobed. The variety *dilatata* of Elliott might be called the type of the species. A remarkable circumstance is, that the earliest flowering specimens, appearing in March, always put forth one apparently naked flowering scape, with a single undeveloped leaf close to it, and another proceeding from a horizontal radicle or stolo at some distance from the flower. The best general characteristic to distinguish this, at first blush, from the next, appears to me to be this,

that in all varieties and at all times there are but few and scattered entire leaves, and the great majority palmately lobed in some shape or other; while the contrary is the case in the next. Besides this never forms *dense* tufts, and frequently no tufts at all. It is only high in an advanced state—in early spring it is very low. It is in flower here from March to May. After inflorescence, the leaves generally grow to a considerable size. No variety of this species, that has fallen under my observation, is found in swamps or bogs. With this exception, they occur in great quantities almost every where.

3. Species. *V. asarifolia*. Pursch in Suppl.

Pursch Suppl. p. 732. Herb. Sherardi.

Elliott p. 299. n. 7. Mr. E. does not appear to have observed it.

Muhl. Cat. first ed. p. 26. n. 10 *variegata* Donn. by Specimens.

Nuttall among his *palmata*, as appears from his remark, that it is in certain cases distinguishable from *V. cucullata*, only by the constancy of the pubescence; which applies to this species exclusively, as all varieties of *palmata*, at all times, are provided with palmately lobed leaves. Some of Mr. Elliott's observations on *palmata* seem to indicate, that he had specimens of *asarifolia* among his. The *asarifolia* of Muhlenberg's catalogue, is a very different plant of the caulescent family, as Mr. Elliott observes correctly.

V. acaulis. Folii *primariis* caespitosissimis, omnibus *eucullatis*, lato-cordatis, interdum reniformibus, magnis; *secundariis* ejusmodi, sed intermixtis raris sagittatis et subpalmatis, lobatis; omnibus crenato-dentatis. Pagina superiori plerumque glabriusculis nervosis, saepe purpureo tinctis. Inferiori pagina, praesertim in junioribus plerumque pilosis, interdum autem tantum in nervis. *Petiolis* crassis, validis, semiteretibus, demum longissimis (ad 10 unc.) semper pilis longis densis tectis. *Stipulis* radicalibus longis, lanceolatis, acuminatis, membranaceis, ad basin petiolorum, saepe trifidis, glabris sed ciliatis. *Folia* quasi flabellatim in petiolos attenuata.

Floribus mediocribus, frequentioribus, contortis in scapis foliis brevioribus purpureis et saepe demum albo-variegatis. *Petalis* magnis plano-reflexis. *Inferiori*, limbo acuminato, saepe bi vel trifido, naviformi, carinato, fundo albescenti,

purpureo-striato; in cavitare pistillacea, barba rara alba ob-
sita. *Binis lateralibus*, intus ex albidis, striatis, barba rigi-
da alba parte superiori adnata. *Binis superioribus*, nec
striatis nec barbatis. *Calycis* laciniis ovato-lanceolatis, gla-
bris, venosis, brevioribus, margine ciliatis. *Stigmate* clava-
to-capitato, recurvo, nec depresso, nec marginato.

Scapis filiformibus, foliis brevioribus, glabriusculis aut
pilis raris. *Stipulis* binis alternis minutis lanceolatis, infra
medium sitis.

Capsulis glabris, minoribus.

Radice crassissima, corallina, obliqua, emittente fibros
longos et caespitibus foliosissimis densis tecta.

I have more frequently found this species, without any
lobed leaves at all, than with them, both during inflores-
cence and afterwards; and it is then that it would resemble
cucullata so much, were it not for the constant pubescence,
which, in the petioles, is always apparent, even when it
nearly disappears in the leaves and scapes. Indeed, the
lobed or palmate interior leaves are always scattered only,
and the great majority cordate, cucullate or reniform, grow-
ing in very dense and large tufts. All have a tendency to
run down into the petiole, though not equally striking in all
specimens. The whole habit is very different from *palmata*;
and as I have studied it in many specimens for several
years, I can aver with confidence, that no degeneration of
the one into the other takes place. I find this species
chiefly on cultivated grassy, steep hill sides and on meadow
margins. It begins to flower early in April and continues
into May. Not unfrequently tufts are met with of more
than one foot diameter. The oblique scaly root then often
exceeds an inch in thickness. This species is very often
found with flowers remarkably variegated, with white blotch-
es, in an irregular way. As observed, the constant pubes-
cence distinguishes it from *cucullata*: to point out the
main characteristics that separate it from *palmata* I thus
contrast them:

V. palmata.

V. asarifolia.

FOL. raris integris; plur. *palmat.* null. = raris *palmat.* plurim. *cordato-cucul-*
latis

PETIOL. tenuioribus interd. glabris. = semiteretibus validis semper pilosis

STIPUL. radic. lanceolatis integris. = saepe divisis, multo longioribus.

SCAPIS longitudine foliorum. = brevioribus foliis

PETALO INFIMO omnino glabro. = barba rara obsita.

STIGMATE depresso-marginato. = globoso-immarginato.

CAESPITIBUS paucifloris et paucifloris = foliosissimis densis, et floribus frequentis.

4. Species. *V. sagittata*. Aiton.

Willdenow. Spec. p. 1160. n. 4.

Nuttall. p. 147. n. 3.

Persoon. Synops. p. 254. n. 4.

Elliott. p. 299. n. 8.

Pursch Fl. p. 172. n. 4.

Muhl. Cat. n. 5, by specimens.

ibid. *dentata* n. 5. a mere var.

New-York Cat. p. 23. n. 3.

V. acaulis. Foliis primariis raris lanceolato-cordatis, breviter petiolatis, exterioribus, crenato-dentatis. (saepe omnino carent.) Secundariis longe petiolatis, frequentioribus, longis, oblongis, vix acuminatis, margine serratis, basi cordato-sagittatis, incis, i. e. dentibus elongatis, majusculis distantibus munitis, ceterum glabriusculis, aut pag. superiori pubescentibus. Petiolis plerumque folia longitudine excedentibus, semiteretibus, pilosiusculis. Stipulis radicalibus longissimis, glabris, lineari-acuminatis.

Floribus inversis, mediocribus, purpureo-coeruleis, in scapis longis. Petalis oblongo-ovatis, intus albescentibus, omnibus albo-barbatis, excepto inferiori nudo; omnibus eleganter purpureo-venosis. Cornu obtuso, postice producto. Calycis laciniis glabris, marginatis, lanceolatis, acuminatis. Stigmatibus rostrato, depresso, marginato.

Scapis filiformibus, subquadratis, folia interdum excedentibus. Stipulis alternis, minutis, distantibus, infra medium sitis.

Capsulis glabris, stylo coronatis.

Radice corallina brevi incrassata; caespites sparsas efformante.

β var. *emarginata* Nuttall p. 147. foliis fere triangularibus.

γ var. *dentata* Pursch p. 172. n. 5. foliis basi truncatis.

This species, although certainly heterophyllous, is so well distinguished by the long-petiolated, oblong, hastately dentate leaves, that it is not likely to be mistaken. I coincide with Mr. Nuttall in regarding his *emarginata* and the *dentata* of Pursch as varieties. I have met with both here rarely. Indeed the *sagittata* itself occurs but rarely with us. Elegant specimens have been found at Chapel-Hill by Professor Mitchell. It appears to be more common towards the north and flowers with us, end of April. In the variety *emarginata* the scape is often a foot long and exceeds the length of the leaves, notwithstanding these are uncommonly long-petiolate. The color of the leaves is remarkably blueish green as in *V. primulaefolia*.

5. Species. *V. triloba*. Nobis.

With some diffidence I venture to propose this new species, notwithstanding its striking characters, because I have found it but rarely. I have however met with it twice or thrice in different years, and in different places—videlicet rich woodland and meadows—constantly under the form here described. At all events it deserves to be pointed out for further observation.

V. acaulis. *Foliis* biformibus; alteris exterioribus lato-reniformibus, margine grosse crenato-dentatis, sinu rectilineo integro; alteris interioribus trilobis. Lobo medio ovato, grosse dentato, acutiusculo. Lobis binis lateralibus, aequalibus, subbidivisis, basi rotundatis, hastatim expansis, margine dentatis. Nervis prominentibus in omnibus. Foliis ceterum glabriusculis aut raris pilis obsitis, colore lutescenti-viridi. *Petiolis* marginatis, glabriusculis, longiusculis, praesertim in foliis trilobatis. *Stipulis* radicalibus breviusculis, lanceolatis, glabris.

Floribus coeruleis, eleganter venosis, subnutantibus. *Petalis* ovatis purpureo-striatis, albo-barbatis, barba longiuscula. *Nectario* minori. Superioribus et lateralibus basi attenuatis. *Calycis* laciniis glabris, lato ovatis, marginatis.

Stigmate recurvo, marginato, depresso.

Scapis brevioribus foliis, angulatis glabris. *Stipulis* minutis distantibus.

Capsula ignota. *Radice* crassa, undique radiculosa.

The whole plant has a glabrous habit, although the leaves are sparingly beset with short hair: they are of a remarkable yellowish green color and spread considerably, although but few in number with but few flowers in the tuft. I have found this *Viola* only late in spring. It approaches nearest to some varieties of *palmata* from which, however, its whole habit appears to separate it.

Remark.—The foregoing are all the species of heterophyllous *Violae* acaules, I have observed, or been able to regard as distinct species. Mr. Elliott's var. d. *heterophylla* of *palmata*, with which I am unacquainted, almost appears to be a distinct species, among the rest. on account of its growth in swamps—where I have never met with any of the recited species. I could however not presume to decide on a plant entirely unknown to me.

The following species, no longer labor under the difficulties of the former. Nevertheless several of them require close examination, in order to be properly distinguished. This is the case between the two *V. cucullata* and *obliqua*, and again between *villosa* and *cordifolia*, so much so, that Mr. Nuttall thinks them the same. My observations upon the two former have led me to conceive, that they ought to be distinguished; as likewise the two latter, where however, I am not perfectly acquainted with *cordifolia*, having seen only dry specimens. The characteristics I have to propose, have been formed upon very often repeated examinations of hundreds of individuals, and will I believe be found to hold good in most instances; though possibly single plants may occur, of so indefinite an appearance, that it may be difficult to determine them. But this happens in almost every Genus which has a number of Species.

6. Species. *V. ovata*. Nuttall.

Pursch. Fl. p. 173. n. 9 *primulaefolia* exclus. Synon. Willdenow.

Muhl. Cat. p. 27. n. 12 *ciliata* by Specimens; altogether the same.

Nuttall p. 148. n. 4.

Although Mr. Elliott cites *Pursch* to his *primulaefolia* it is clear that he describes the true Linnean one and not the present species.

New-York Cat. p. 28. n. 6.

V. acaulis: *Folius* oblique ovatis, acuminatis, basi subcordatis in petiolos decurrentibus, eosque alatos reddentibus, crenatis, ad basin saepe lacerato-dentatis, utrinque pubescentibus (rarius aetate proveciori glabriusculis.) *Petiolis* brevioribus, statu juniore brevissimis, pilosis. *Stipulis* radicalibus lato-lanceolatis, oblique acuminato-truncatis, in truncatura dentatis, ceterum ciliatis, uncialibus, petiolum basi amplectentibus. *Foliis* nervosis.

Floribus maxime nutantibus, majusculis, pulchre coeruleis. *Petalis* obovatis; binis lateralibus longiuscule albarbatis et subvenosis; infimo purpureo-venoso, barba sparsa; superioribus nudis. *Cornu* aut nectario obtuso. *Calycis* laciniis subreflexis, pilosis, oblongo-lanceolatis, postice elongatis attenuatis. *Stigmate* recurvo subrostrato, non depresso.

Scapis tetragonis, saepe sursum tortiusculis, pilosis, demum elongatis. *Stipulis* linearibus oppositis.

Capsulis glabris. *Radice* perpendiculari crassa. *Caespitibus* foliosis compactis, habitu stricto, crescit, plerumque undique canopubescentibus.

It is surprising that Mr. Pursh should have combined this extremely distinct species, having a very predominant habit of pubescence and large bright blue flowers, with the Linnean *primulaefolia*, whose habit and manner of inflorescence is so widely different. Mr. Nuttall excellently points out the distinction. The present species invariably grows on dry sunny hills—preferring a gravelly soil and flowers early in April; the other, rather later, always adheres to moist swampy places, and is much more nearly allied to *lanceolata* and *blanda* than to this. Nuttall says the scape of *ovata* is shorter than the leaves. I have found it so, in a few instances in very dense tufts; in general however the scapes are much longer than the leaves whose petioles are at first unusually short. I have met with glabrous specimens in peculiar situations; otherwise the pubescence is pretty constant, and especially striking on the margins of the leaves; which caused Muhlenberg to call this species *ciliata*. It is common with us.

7. Species. *V. cucullata*. Aiton.

The difference between this and *obliqua* of Aiton, I am satisfied, is a specific one, and the diagnostic characters constant. Besides the general habit, these are however only to be ascertained by minute examination. Hence, I presume, specimens of the one have been often mistaken for the other, which appears to have induced Mr. Nuttall to reject the *obliqua* altogether, the name of which, is certainly very inadequate. I have done my best to make out the synonymy to each, without being perfectly certain in every instance.

Willdenow p. 1162. n. 7. appears decidedly to belong to *cucullata*.

Persoon Synops p. 254. n. 8. likewise.

Pursh. Fl. p. 173. n. 10—is slightly characterised as *cucullata*; but probably is intended exclusively as such.

Elliott p. 298. n. 6—refers probably to both. Some part of his description belongs to *cucullata* beyond a doubt—the want of beard on the lower petal however points to *obliqua*; thither I refer the *cordata* of Walter.

Pursch Fl. p. 173. n. 12. *V. papilionacea* is certainly but a variety. I have often met with yellow bearded specimens—and can find no other distinguishing mark.

Muhl. Cat. n. 11. by specimens.

Nuttall p. 148. n. 5. applies to both.

V. acaulis. *Foliis* cordatis, basi cucullatis, dentato-serratis, glabris, venosis. *Petiolis* subcanaliculatis, glabris, brevioribus sequente. *Stipulis* radicalibus, minoribus, linearibus, marcidis, ciliatis.

Floribus oblique flexis violaceis, coeruleis, saepe exalbidis. *Petalis* latoribus; infimo, limbo rotundato, barbato. *Binis* lateralibus etiam barbatis. *Barba* longa rigida cylindracea. *Petalis* omnibus intus albescentibus. *Calycis* laciniis glabris lanceolatis.

Scapis brevioribus, teretibus; *stipulis* minutis, infernis, alternis.

Capsulis glabris. *Radice* crassiuscula, radiculosa.

With us this is the earliest of all and common in March. At first it is generally very low, and flowers before many leaves are expanded. It varies considerably in the relative length of scape and leaves as it advances, and forms considerable tufts in grassy spots and meadows almost every where; but it is less exclusively attached to moist places. The cucullate form of the younger leaves (the angles at base involute) is common to both species, although more conspicuous in this and generally disappears after the leaves are full grown. The whole plant is perfectly glabrous, but opaque. Lobed leaves do rarely occur, as anomalies, I think—but a purplish cast is frequently observable on the lower surface.

8. Species. *V. obliqua.* Aiton.

Waldenow p. 1161. n. 6. *Persoon* Synops p. 254. n. 7.

Pursch p. 172. n. 8. *Muhl.* Cat n. 9. by specimens.

Walter's cordata and *Elliott's cucullata* in part.

V. acaulis. *Foliis* non tam cucullatis, minoribus, strictioribus, ceterum similibus prioris, glaberrimis saepe splendentibus. *Petiolis* canaliculatis longissimis (folia multoties excedentibus) glabris. *Stipulis* radicalibus magnis, uncialibus, lanceolatis, acuminatis, ciliatis.

Floribus oblique flexis, ime coeruleis (saepius coloris Indigo.) *Petalis* omnibus angustioribus, basi albescentibus, venis luteis et purpureis pictis. *Binis* lateralibus barbatis,

barba brevissima; globoso-clavata. Infimo nudo, limbo acuto nec rotundato, postice naviformi, carinato. *Calycis* laciniis glabris, submarginatis, oblongis acutis.

Scapis quadratis, canaliculatis, longioribus foliis. *Stipulis* binis brevissimis versus apicem scapi sitis.

Capsulis glabris. *Radice* saepe obliqua parum radiculosa.

The general habit of this species, is much taller and stricter than the former species. The flowers have a remarkably deep blue or indigo color with scarcely a tint of red in them. It is almost exclusively found in swampy meadows, or on the grassy margin of small branches. Not rarely it flowers there indiscriminately with the former, although it begins to appear rather later. The following contrast of the characteristics will serve to distinguish the two species.

V. cucullata

V. obliqua

Stipulis radical: minoribus, linearibus. = majoribus, uncialibus, lanceolatis.

Scapis: teretibus, brevioribus. = quadratis, longioribus.

Petalis infimo: rotundato, barbato. = limbo acuto, carinato, imberbi.

Barba lateralium; magna, cylindrica. = brevissima, globoso-clavata.

9. Species. *V. villosa*.

Walter and Elliott.

Elliott. p. 297. n. 3.

Walter. p. 219.

Nuttall, p. 148. n. 6. exclusive of var β *cordifolia*.

Muhl. Cat n. 2. *barbata*, by specimens, confounded however with *cordifolia*.

The *Sororia* of Pursch and Willdenow belongs decidedly to the next, which I think specifically different.

V. Acaulis. *Foliis* rotundato-cordatis ac reniformibus, obtusis, crenatis, terrae adpressis planissimis tenuioribus; sinu parvo sed aperto, rectilineo, integro; pagina superiori pilis longis pubescentibus, immo pube canescentibus; variegatis venis purpurascens, demum et in siccis evanidis; pagina inferiori, glabris, purpureo tinctis. *Petiolis* brevioribus, glabris, marginatis, diffusis. *Stipulis* radicalibus minutis, purpurascens.

Floribus minoribus, horizontalibus, rosaceo-purpureis. *Petalis* limbo rotundatis, postice attenuatis; lateralibus, barba longa alba; infimo nudo, fundo albescenti, purpureo-striato. *Calycis* laciniis glabris, punctatis, non ciliatis sed margine albescenti undulato, postice auriculatis. *Stigmate* deflexo, marginato, cupulaeformi.

Scapis longioribus foliis, subangulatis, glabris, rubro punctatis. *Stipulis* minutis, oppositis, versus basin sitis.

Capsulis scabriusculis. *Radice* tenui obliqua, mox in radiculos abiente.

Caespitibus paucifoliosis, saepe bifoliis crescit—sub uniflora.

A very late flowering species, and found by me exclusively on steep shady hill sides, looking to the north, where *Anemone hepatica* usually grows. The leaves are always few, and flat, incumbent on the ground and in a fresh state, generally veined purplish and white, and much smaller than of any of the preceding species. The veined appearance vanishes when dry. They are rather more consistent than the leaves of the former species but not near as thick as in the following. The opening of the sinus is small and by a rectilinear slant, without serratures. It flowers late in April and in May. No kind of affinity to *V. Sagittata*. The long hirsute pubescence of the upper surface of the leaves, gives them frequently a hoary aspect.

10. Species. *V. cordifolia*. Nuttall.

Willdenow in Hort. Berol. 1. T. 72. *Sororia*.

Pursch, p, 173, n. 11. *Sororia*.

Nuttall, p, 148, n. 6. var β . *cordifolia*.

V. acaulis. *Folius* crassis, orbiculato-cordatis, sinu clauso rotundato, crenatis, planis, terrae adpressis, pagina superiori hirsutis, subtus glabris. *Petiolis* validis, brevissimis, flexuosis, quasi alatis, glabriusculis. *Stipulis* radicalibus, minutissimis, subulatis.

Floribus rosaceo-coeruleis. *Petalis* breviusculis obovatis; binis lateralibus sparsim barbatis, ut etiam infimo, omnibus multistriatis. *Calycis* laciniis angustis, brevibus, obtusiusculis, glabris, postice vix productis. *Stigmate* parvo, rostrato, depresso.

Scapis longitudine foliorum. *Stipulis* minutissimis.

Capsula glabra. *Radice* brevi tenuiuscula radiculosa.

Caespitibus subfoliosis, floribus frequentioribus crescit.

Although I have seen this species only in dry specimens from Pennsylvania and Virginia, where it was picked up by my esteemed friend Rev. C. F. Denke, in the mountains, I conceive it ought to be separated from the *villosa* of Elliott, on account of the general habit, the very thick leaves, with a sinus not only roundedly closed, but frequently lapping over, the very short thick bent petioles, very small radical stipules and smooth fruit. The shape of the petals is like-

wise different, and that of the laciniae of the Calyx still more strikingly; not to mention the stigma. Mr. Z. Collins of Philadelphia has before me, according to Nuttall, considered this a distinct species—and it is assuredly the *sororia* of Willdenow.—*May*.

Note. The following species so amply described by Mr. Nuttall and Michaux is the only one of this family, with which I am utterly unacquainted; as I have never met with any *stemless* *viola* having yellowish flowers. It appears to me to form a transition from the bluish petalled acaulescent *Violae*, to the white petalled ones; which upon the whole are so manifestly different, in their whole habit of inflorescence, that a very good subdivision of the family might be established, dividing it into: a) *Violae* acaules, floribus *papilionaceis*, majoribus, coerulescentibus: (b) *Violae* acaules, floribus *regularioribus*, minoribus, candidis, between which *V. rotundifolia*, would be intermediate, and *clandestina* an appendix.

The white flowers sometimes and indeed frequently met with in all the foregoing species, all shew, that it is owing to a fading of the blue that they are white, while those of the proposed white subdivision as plainly demonstrate the contrary; besides their difference of shape and size.

11. Species. *V. rotundifolia*. Michaux.

Nuttall p. 149. n. 7. Michaux p. 150.

Elliott p. 298 n. 4.

V. acaulis. Foliis crassis, magnis, orbiculato-cordatis, sinu clauso, leviter dentatis, terrae adpressis, glabriusculis. *Petiolis* pubescentibus. *Floribus* lutescentibus, in scapis brevibus ante foliorum expansionem. *Petalis* binis lateralibus striatis, subbarbatis, striis 3, barba interruptis, infimo minori, striis bifidis, lineis cartilagineis transversalibus. *Calycis* laciniis oblongis obtusis. *Stigmate* glabro, minori, recurvo in stylo brevi crasso.

Scapis brevibus. (Nuttall.)

This remarkable species has been found on the shady banks of Wishahikon near Philadelphia by Mr. Rafinesque and Nuttall; the latter has likewise met with it in the mountains of North-Carolina. I have not been so fortunate as yet. It is undoubtedly a very distinct species. Mr. Pursch has very improperly cited Michaux's plant to his *clandestina* with which it can have no affinity whatever.

12. Species. *V. lanceolata*. Linn.*Willdenow*, Spec. p. 1161. n. 5.*Elliott*, p. 296. n. 1.*Persoon*, Synops. p. 254. n. 5.*Muhl*, Cat, n. 6, by Specimens.*Michaux*, p. 150.*New-York*, Cat, n. 4.*Pursch*, Fl. p. 172. n. 6.*Nuttall*, p. 150. n. 10.

I conceive it doubtful whether the Siberian plant of the same name, as described by *Gmelin*, actually is this species. *Willdenow* never saw either.

V. acaulis. *Foliis* glabris, nervis suboppositis, lanceolatis, angustis, longiusculis, basi in petiolos sensim attenuatis, obtusiusculis, subserratis. *Stipulis* radicalibus linearilanceolatis integris. *Petiolis* brevioribus foliis et cum his stricte erectis.

Floribus solitariis, candidis, parvis, regularibus, nutantibus in scapis apice incurvis. *Petalo* infimo, purpureo-striato; omnibus imberbibus, subaequalibus, (*Elliott*. 2 lateralibus barbatis.) *Calycis* laciniis angustis, acutis, glabris. *Stigmate* recurvo, rostrato, in stylo brevi, capitulo emarginato. Inodorata. *Capsulis* trigonis glabris. *Radice* perpendiculari tenuiuscula.

This beautiful species I have never seen growing; although I have excellent specimens, from Canada, Pennsylvania and the Cherokee country. *Mr. Elliott* cites it as common in the Southern pine barrens, although rare on the sea coast. Mine are all beardless, perhaps *Mr. Elliott's* may be a variety. This species is nearly related to the following, but the narrow lanceolate leaves so remarkably attenuated into the petiole and its perfect glabrosity, distinguish it sufficiently.

13. Species. *V. primulaefolia*. Linn.*Willdenow*, p. 1162, n. 8.*Elliott*, p. 297, n. 2. exclus. Synon. *Pursch*.*Persoon*, p. 254. n. 9.*Nuttall*, p. 149. n. 9.*Muhl*. Cat. n. 7. by specimens. *New-York*, Cat. n. 7.

Pursch has most probably confounded it with his *lanceolata*.

This is likewise a native of Siberia.

V. acaulis. *Foliis* glabris aut tantum in nervis pilosis, oblongis, basi subcordatis abruptim in petiolos decurrentibus, apice obtusis, nervis pinnatim dispositis; omnino similibus foliis *primulae veris*. *Petiolis* junioribus rubicundis, subtus pilosis; demum longioribus foliis. *Stipulis* radicalibus glabris, longis, linearibus, acuminatis, sparsim ciliatis.

Floribus minutis, candidis, saepe obliquis; *petalis* subaequalibus. Infimo eleganter nigro striato; binis lateralibus

brevi-striatis, barba parca brevi obsitis; superioribus omnino candidis. *Calycis* laciniis obtusis. *Stigmate* manifestum rostrato, capitato.

Scapis rubicundis angulosis, longitudine foliorum. *Stipulis* oppositis subulatis supra medium sitis.

Capsulis glabris. *Radice* obliqua, fasciculosa, subsquamosa.

No doubt this is a very good species, although allied both to the former and the following one. It is the most common white *Viola* here and is found in wet meadows, ditches, and wet grassy spots in the woods, in April. The flowers are very odoriferous and uncommonly small in proportion to the leaves, which often grow to an enormous size; exactly resembling those of *Primula*. The *Aecidium Viola* is not uncommon on this species.

14. Species. *V. blanda*.

Willdenow.

Willdenow, Hort. Berol. l. T. 24

Elliott, p. 298. n. 5.

Pursch, p. 172. n. 7.

Nuttall, p. 149. n. 8.

Muhl. Cat. n. 13. by Specimens.

V. acaulis. *Foliis* planiusculis, glabris aut superne pilis raris obsitis, lato-cordatis, nervis pinnatis glabris cum pagina inferiori; plerisque acutiusculis, raris rotundatis, remote serratis, colore luteo-viridi. *Petiolis* glabris, longiusculis, decumbentibus. Sinu foliorum subclauso, rotundato; foliis, substantia, tenuissimis.

Floribus albis, interdum lutescentibus, odoratis, parvis. *Petalo* infimo lanceolato, purpureo striato et venoso, barba tenuissima exornato; ceteris substriatis imberbibus. *Calycis* laciniis oblongo-linearibus obtusis. *Stigmate* capitato depresso, acute marginato, recurvato.

Scapis filiformibus, saepe decumbentibus. *Stipulis* subulatis in medio. *Capsulis* glabris. *Radice* fasciculosa.

I find this kind exclusively with us on mountain brooks and shady wet rocks; the leaves are generally spread flat on the ground and vary from a very small size, to a considerable one. They are always of a light yellowish green color and very thin consistence, resembling a good deal those of *clandestina*. Their number is generally small and distant. It has a handsome, delicate, small flower, remarkably fine scented. Flowers in April and May.

15. Species. *V. clandestina*. Pursch.

Pursch, p. 173. n. 13.

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V. acaulis caespitosa. *Folius* suborbiculatis, obtusiusculis, magnis, crenato-serratis, serraturis glandulosis; tenuibus, glabriusculis; Sinu clauso cordatis. *Petiolis* multo brevioribus foliis, glabris, aut pilis raris obsitis. *Stipulis* radicalibus, ovatis, latis, brevibus. *Stolonibus* floriferis.

Floribus ereconditis—i. e. foliis et ligno putrido tectis, minutis, chocolatis. *Petalis* linearibus, calyce vix longioribus. *Stylo* longiusculo. *Stigmate* recto capitato.

Scapis brevissimis, pilis adspersis; *Stipulis* subulatis in apicibus.

Capsulis glaberrimis subsplendentibus, saepe reconditis.

Radice stolonifera, radiculosa. *Caespitibus* foliosis.

Mr. Nuttall never having seen this plant, as it would appear, doubts of its authenticity, on account of the great anomaly in the petals, and is inclined to refer Pursch to *villosa*. With this species however it has no affinity, being nearest allied to *blanda*. But I think, whoever has seen even dry specimens, such as I received from my late friend Rev. H. Steinhauer of Bethlehem, found on the Pocono mountain, cannot possibly doubt the species. Mr. Steinhauer shewed me an elegant drawing he had made from fresh specimens; the petals exactly as described by Pursch, and shewing some affinity to *concolor* in their habit. It grows in large tufts, spreading its light green leaves in every direction. They are of thin consistence and sprinkled with hair on the upper side. My specimens have only apetalous flowers.

This species ought to be closer observed and better described. The vulgar appellation of *Heal all* which Pursch says it goes by, is applied to a great number of very different plants.

B. *Violae caulescentes.* *Violae producing stems.*

Species of Europe, belonging to this family:

1. *V. canina*. 2. *V. montana*. 3. *V. lactea*. 4. *V. nummularifolia*. 5. *V. cenisia*. 6. *V. mirabilis*. 7. *V. biflora*. 8. *V. tricolor* var. *bicolor*. 9. *V. arvensis*. 10. *V. Rothii*. 11. *V. rothomagensis*. 12. *V. lutea*. 13. *V. grandiflora*. 14. *V. zoysii*. 15. *V. pumila*. 16. *V. calcarata*. 17. *V. cornuta*.

Those in Italic are in my collection.

Remarks.—The *caulescent* *Violae* of America appear to me to have been less accurately observed than the former family, although I think they are rather easier to be distinguished. A good number have been rather incautiously referred to such from whom they manifestly differ. I find it impossible to unravel the species generally received, without establishing some new ones; although I am persuaded that specimens of most of these, have been under the eyes of other Botanists, without being sufficiently distinguished. The attention which I have bestowed upon such, as grow in our vicinity (including the greater number) has, I hope enabled me to discriminate properly. The *V. striata* and *V. debilis* of authors appear to have been particularly loosely observed, and form an aggregate of very distinct species, rendering it altogether impossible to say which is meant in every instance. The *V. ochroleuca*; *V. repens*; *V. debilis*; and *V. uliginosa* attempted to be here correctly established, have, I have reason to presume, been comprehended hitherto under one or the other of the above two names. My *V. striata* is altogether a different species from these, and has probably not been before observed. It was first pointed out to me in our vicinity, by Mr. John Leconte, who was of opinion that it had been no where described. I call it *striata* with him, because that name certainly belongs more appropriately to this *Viola*, than to any of those to which it has before been applied. The *striata* of authors comprizes as I judge, my two species *V. ochroleuca* and *V. repens*. (I should have named the latter *decumbens* if there was not already a species of that name indigenous to the Cape of Good-Hope.) My *striata* approaches nearer to *V. pubescens* and *eriophora* than to the above.

With regard to the *caulescent* *Violae* in general it may be observed that they appear later in the season than the former family; and have a marked predilection for the yellowish color in their flowers.

Besides the alterations above recited, I have ventured to propose a new species in a very handsome little *Viola* from Labrador, with which I begin, as it is apparently the least *caulescent* of the family.

16. Species. *V. punctata*. Nobis. from Labrador.

Perhaps somewhat related to *V. uniflora*. Pers. n. 28. of Siberia, from which it differs however by Willdenow's re-

mark, that that bears yellow flowers. Besides the description of both authors contains none of the characteristics of ours.

V. caulescens; *caule* breviusculo, tenui, stolonifero, paucifolioso, simplici, subunifloro. *Stipulis* radicalibus et ad basin caulis, lineari-lanceolatis ciliatis; axillaribus longissimis lineari-acuminatis.

Folius radicalibus caespitosis, caulinis suboppositis; omnibus longe petiolatis, exacte cordatis, obtusiusculis, parvis, crenatis; pagina superiori punctis glandulosis elevatis tectis, inferiori impressis; ceterum venosis, substantia crassiuscula, pagina superiori vix perceptibiliter hirtis, subtus glabris. *Petiolis* glabris.

Floribus majusculis, coeruleis, in *pedunculo* longiusculo, solitario, anguloso; *stipulis* binis oppositis lanceolatis versus apicem sitis. *Petalis* rotundatis majusculis; lateralibus tenuissime albo-barbatis. *Nectario* longiusculo, recurvo, rostro recurvo terminato. *Calycis* laciniis lanceolatis, acuminatis, glabris, postice rotundatis productis.

Caulis infra caespitem foliorum incrassatus, in *radicem* longam abiens. *Capsula* deest.

The horn of the lower petal or nectarium is highly remarkable, terminating by a bend upwards in a short recurved rostrum. The leaves have some resemblance to those of *Pyrola uniflora* and differ from all other *Violae* by their glandular punctures. In all my specimens, there is but one flower to the stalk, and that considerably elevated above the leaves by a long peduncle. I received this interesting species, among a considerable collection of Labrador plants, from my revered friend, R. Rev. C. G. Hueffel now of Bethlehem.

17. Species. *V. canadensis*. Aiton and Linn.

Willdenow p. 1166 n. 17. *Nuttall* p. 150 n. 11.

Persoon Syn. p. 254 n. 20. *Muhl.* Cat. n. 15 by specimens.

Pursch p. 174. n. 14. *Michaux* p. 150.

Elliot p. 301. n. 11. *New-York* Cat. n. 9.

V. caulescens; *Caule* altissimo erecto subsimplici, nudiusculo i. e. apice foliosiori, tereti, glabro.

Folius alternis in axillis floriferis, cordatis, basi latissima, longe acuminatis, dentatis serratis, subtus pallidis, glabris, in pagina superiori pilis raris adspersis, luteo-viridibus, quasi angulo recto e petiolis reflexis, nervosis, magnis, tenui-

bus. *Petiolis* folio brevioribus, in summis brevissimis. *Stipulis* axillaribus binis oppositis, erectis, lato-lanceolatis, marcidis, integris.

Floribus majusculis, extus roseo-coerulescentibus—intus albescentibus, in *pedunculis* axillaribus brevioribus foliis, stipulis linearibus sub apicem. *Petalis* longis angustis, lateralibus subbarbatis, striatis. *Cornu* obtuso vix producto. *Calycis* laciniis longe acuminatis, glabris, albo-marginatis. *Stylo* brevi compresso; *stigmate* capitato, pubescentia conspicua utrinque. *Capcula* leviter pubescente. *Radice* tenui.

A tall growing elegant species, found here exclusively in our higher mountains and there rarely. It appears to be more common to the north; and often attains a height of ten or more inches, with a proportionably slender stem; below there are but few leaves. The flowers are remarkable for the shortness of the horn or nectary and the long attenuated narrow petals. These are purple outside and whitish within, finely striated. Willdenow's description is a very good one. It flowers late in May and beginning of June. Northwardly it seems by the New-York catalogue to flower still later, in July. It is difficult to express the manner in which the leaves are almost rectangularly bent down—but it is a striking habit to the observer.

18. Species. *V. ochroleuca*. Nobis.

Willdenow. p. 1166. n. 18. *striata*?

Persoon p. 255. n. 21. *striata*.

Pursch. p. 174. *striata* very uncertain to which he refers.

Nuttall p. 150. n. 12. *striata* decidedly our species.

The *striata* of Elliott I think must belong to my *debilis*, as does the *striata* of Muhl. Cat. by specimens.

I have very particularly studied this and the two following species—and feel satisfied that they are specifically very distinct.

V. caulescens: *Caulibus*, erectiusculis, ramosis, foliosis a basi, angulosis, crassis, glabris, purpurascensibus.

Folius omnibus minoribus longiuscule petiolatis, alternis, diffusis; inferioribus rotundato-cordatis, crenato-serratis, obtusis; superioribus paulo majoribus, breviter acuminatis. Omnibus pagina superiori minutim pubescentibus, subtus solummodo in nervis. *Stipulis* axillaribus oppositis,

maximis, oblongo-lanceolatis, margine dentibus majusculis distantibus quasi ciliatis. *Petiolis* canaliculatis glabris.

Floribus maximis, ochroleucis, aut pallide sulphureis, nutantibus in *pedunculis* longioribus foliis, filiformibus, apice longissime stipulatis, stipulis linearibus acuminatis. *Petalis* magnis, limbo rotundatis, basi attenuatis. Binis lateralibus barba concolore profuse tectis, ceteris nudis; infimo striis nigris picto. *Cornu* postice longiuscule producto, obtuso. *Calycis* laciniis longissimis angustis, acuminatis, margine ciliato. *Stigmate* recurvo subpubesc.

Capsulis glabris. *Radice* tenuiuscula.

This is by far the largest flowered species of the family. The stem rises in spreading tufts to a considerable height, generally in a half bent way. It flowers in abundance before the leaves are fully expanded, and is highly remarkable for the unusual ochre-color of its fine flowers. I have met with it in borders of ponds and meadows in April and along Dan river, towards the Saura mountains, attached to rich soil. The next, is the only species with which it is nearly allied—but can readily be distinguished by its size, erect habit, and very differently shaped stipules.

19. Species. *V. repens* Nobis.

If observed by others, it has been comprehended among the former in such a manner, as to render it impossible to point out references.

V. caulescens, decumbens, subrepens, stolonifera. *Caulibus* crassiusculis subangulosis, ramosis, foliosis, decumbentibus, minoribus quam in priori. *Stolonibus* longe lateque irrepentibus. *Stipulis* maximis, ovato-lanceolatis, margine ciliis longissimis viridibus densis exornatis, ex axillis foliorum, cauli undique adpressis, fere ut in *Violis* stipulaceis europaeis.

Foliis inferioribus reniformibus, acutis, crenatis, glabriusculis, aut ut in priori: superioribus cordatis, subcucullatis, dentato-serratis. *Petiolis* longiusculis, glabris, submarginatis. Folia omnia minora quam in priori.

Floribus minoribus ex luteo-albescentibus. *Petalo* infimo multo minori ceteris; lateralibus barba longa alba. *Nectario* breviusculo. *Calycis* laciniis lanceolatis, multo latioribus quam in priori, substriatis, acuminatis, ciliatis. *Pedunculis* axillaribus breviusculis, in ipso apice longe stipulatis.

Capsula non observata. *Radice* ut in priori.

This is of a much smaller size than the former and well distinguished by its decumbent, spreading and even creeping growth, smaller flowers and their white beard, but no less, by the broad and strongly fringed opposite stipules, which at first might be taken for pinnatifid ones, and the very small lower petal. It has been found here exclusively on the rocks of the Saura mountains, where it forms considerable patches. It flowers in May. I contrast the two Species thus :

*V. ochroleuca.**V. repens.*

CAULIBUS assurgentibus, erectis, = decumbentibus, stoloniferis minoribus.

FOLIIS cordatis, obtusis ac acuminatis = reniformibus et cordatis, minoribus.

Floribus maximis; barba concolore = minoribus; barba alba.

Petalo infimo magno, rotundato = minutissimo, aequali.

Stipulis axillaribus margine dentibus distantibus dentatis, maximis, oblongis = margine longissime denseque ciliatis, magnis ovatis, caule adpressis.

20. Species. *V. debilis*. Michaux.

Michaux. p. 150. *Elliott striata* p. 301. n. 12.

Pursch p. 174. n. 16. *Walter canina* ? p. 219.

Nuttall p. 150. n. 13. *Muhl. Cat. Striata* n. 17 by specimens.

I have some suspicion that Elliott's specimens collected by Dr. Macbride may belong to the *uliginosa* of Muhlenberg, called *asarifolia* in his catalogue. The rest of the synonymy I believe is correct.

V. caulescens, glaberrima, decumbens et erecta. Caulibus caespitose ex radicibus provenientes, foliosis, brevibus.

Foliis reniformi-cordatis, obtusiusculis, basi saepe cucullatis, saepe suborbiculatis, crenatis, utrinque glaberrimis, e sinu quasi in petiolos subdecurrentibus; minoribus. Petiolis diffusis longiusculis. Stipulis axillaribus lato-lanceolatis subdivisis, ad basin tantum serrato-ciliatis.

Floribus pallide coeruleis, nutantibus in pedunculis medio stipulatis, longiusculis, axillaribus, folia excedentibus. Petalis omnibus limbo rotundatis, binis lateralibus parce barbatis; infimo venoso. Nectario longo, postice valde porrecto, attenuato. Calycis laciniis linearibus, angustis, glabris, albo-marginatis, postice truncatis. Stigmate tubuloso, rostrato, papilloso.

Radice obliqua, longiuscula, radiculosa. Capsula non observata.

There is an approach to *V. rostrata* apparent in this distinct species, though the nectary is only half as long. It is rare with us, and attached only to our mountains. The lower petal is very broad in limbo. On Hunting creek, Surry county, I met with a very erect variety. The pale blue color is unusual too.

21. Species. *V. uliginosa*. Muhlenberg.
Muhl. Cat. asarifolia et uliginosa. n. 18. by specimens.
 Elliott refers to this, page. 299.

New-York Cat. uliginosa p. 28, n. 10. This is very probably our species.

V. caulescens. Caulibus debilibus tenuibus, assurgentibus, flexuosis, ramosis, inferno nudis.

Folius constanter cordato-acuminatis, serratis, majoribus, distantibus, alternis, glabris aut tantum in nervis pilosiusculis. *Petiolis* longitudine foliorum aut brevioribus. *Stipulis* axillaribus acuminato-lanceolatis tenuiter ciliatis; latioribus in caule.

Floribus minutissimis pro ratione, in *pedunculis* filiformibus, axillaribus, flexuosis, longitudine foliorum, apice subulato stipulatis. *Petalis* coerulescentibus, angustis; infimo longiuscule albo-barbato. *Nectario* brevissimo non porrecto.

Calycis laciniis longis, acuminatis, margine ciliatis.

Radice fasciculosa, radiculosa. *Capsula* deest.

This species I have never seen in a fresh state; but have very frequently had it sent to me from the Cherokee country with remarkably constant appearance. The stem has generally but few leaves, larger than in the former species, and well distinguished by their cordate acuminate shape. The acumen is always somewhat obliquely turned—and the assurgent stem generally a little zigzag. The very small flowers—least in size of any blueish violet, with nearly equal petals, resembles a little the white flowered *Viola* of the former family. The short nectary at once separates it from *debilis*. It appears to grow high—as I have specimens which exceed eight inches. The time of flowering is unknown to me. Muhlenberg found it in Pennsylvania in April.

22. Species. *V. rostrata*. Muhlenberg.

Pursh. p. 174. n. 17. *Muhl. Cat.* n. 21. by specimens.

Nuttall p. 150. n. 14. *Torrey.* New-York by specimens.

V. caulescens; glabra. Caulibus diffusis, e radice foliosis, erectis, angulatis.

Folia cordatis acutis, glabris, eroso-dentatis; inferioribus longe-petiolatis, ceteris breviter. *Stipulis* axillaribus lanceolatis, serrato-ciliatis. *Petiolis* glabris, marginatis.

Floribus coeruleis, nectario longissimo, rostrato, porrecto, corollam duplo excedente. *Petalis* omnibus imberbibus, extus purpureis. *Pedunculis* duplo longioribus foliis, medio stipulatis, stipulis alternis. *Calycis* laciniis brevibus, acuminatis. *Stigmate* glabro, erecto, attenuato-clavato, erostrato.

Capsula deest. *Radice* perpendiculari non radiculosa.

This very distinct *Viola* does not grow with us, and probably not in the Southern States. Very handsome specimens from Pennsylvania and from Albany, New-York, are in my collection. It grows on shady rocks.

23. Species. *V. tripartita*. Elliott.

Elliott, p. 302. n. 14.

Nuttall, p. 150. n. 16.

V. caulescens; pilosa; caule simplicissimo, teretiusculo, subpedali; apice tantum folioso.

Folia paucis in summo caule, profunde tripartitis, lobis lanceolatis dentatis: pagina inferiori, praesertim in nervis pilosis. *Petiolis* breviusculis pilosis. *Stipulis* axillaribus minutis villosis, ovatis aut lanceolatis, integris aut subserratis, medio nervo percurrente costatis.

Floribus mediocribus luteis, in *pedunculis* axillaribus filiformibus, brevibus, medio stipulatis. *Petalis* superioribus purpureo-striatis, non barbatis. *Nectario* brevissimo, vix producto, obtuso. *Calycis* laciniis breviusculis acutis. *Stigmate* globoso pubescente.

Radice fasciculosa, ex radiculis paucis crassis. *Capsula* non visa.

No doubt this species, as Mr. Nuttall observes, belongs to the relationship of *pubescens* as well as the two following ones; but it is obviously a distinct species, being the only caulescent *Viola* with lobed leaves. We have met with it in our neighbourhood very rarely indeed, but in good specimens agreeing with Mr. Elliott's description in every respect, only, not exceeding six or eight inches in height. The petals have outside in some instances a purplish cast like those of *hastata*, and like that it begins to flower before the leaves are fully expanded. It was found in shady woods in May.

24. Species. *V. pubescens*. Aiton et Linn.

Willdenow, p. 1166. n. 19. Michaux, p. 149. *pennsylvanica*.

Persoon, p. 255. n. 22.

p. 255. n. 23. *pennsylvanica* appears not to differ.

Nuttall, p. 150. n. 15. Muhl. Cat. n. 16: by specimens.

Pursh, p. 174. n. 18. New York, Cat. n. 11.

V. caulescens, tota villosa pubescens. Caulibus subteretibus, simplicibus, erectis, villosis, apice tantum foliosis; subangulosis.

Folius lato-cordatis magnis, eroso-dentatis, plus minusve longe acuminatis, utrinque pilosis, villosis, canescentibus, nervis prominulosis; breviuscule petiolatis. Petiolis canaliculatis in folia dilatatis. Stipulis axillaribus marcidis, ovatis, villosis, subserratis mediocribus.

Floribus majusculis, luteis; in pedunculis axillaribus, brevioribus foliis, villosis, versus apicem incurvis, stipulatis. Petalis lateralibus albo-barbatis; infimo purpureo-striato (ut etiam lateralia;) superioribus minoribus, unicoloribus. Nectario abrupte inflexo acuminato. Calycis laciniis glabris aut villosis, ovato-lanceolatis, subobtusis. Stigmate globoso, utrinque pubescent.

Capsulis glabris (Nuttall; etiam villosis.)

Radice fasciculosa.

Stipulis in nuda parte caulis inferne, ovatis integris obtusis.

I scarcely know what to think of this species, so extremely different from the next in several momentous particulars; and yet apparently united by Nuttall therewith. The *pubescens* or *pennsylvanica* never is met with here, although I have frequently found it in the northern states myself, and am possessed of numerous good specimens—while the next is very common. Yet it is clear that the specific distinction cannot be rested on the smooth or villous capsule. I possess specimens of undoubted *pubescens* with perfectly smooth, and others with closely villous capsules. I must therefore conclude that the var β *eriocarpon* of Nuttall is not my *eriocarpa* as I at first supposed, but really a variety of *pubescens*; and that my next species does not occur in Pennsylvania; although I confess I do not feel perfectly satisfied upon the subject, and hope to be able to investigate it further. What I exclusively call *pubescens* is always remarkably pubescent, entirely erect, with very broad cor-

date acuminate yellowish leaves only at the summit, the caulis otherwise naked; sometimes a single long petiolate leaf proceeds, beside the stem, from the root. The curious and unusual shape of the nectary suddenly bent inwardly and pointed, forms the most striking feature of difference. I doubt whether this has been found in the southern states.

25. Species. *V. eriocarpa*. Nobis.

An Nuttall p. 150 n. 15. var. of *pubescens*?

I doubt the more that Nuttall's variety is my new species, as he expressly remarks, that in that the stipules are smaller, while the uncommon large size of the stipules in mine, forms a prominent distinction of it from *pubescens*. And yet Mr. Torrey of New-York informs me that Mr. Nuttall having seen a specimen of this among plants, I sent to Mr. Torrey, doubted of its being distinct. I describe mine thus.

V. caulescens, scabriuscula. Caulibus decumbentibus, demum assurgentibus, diffusis, crassiusculis, angulosis, flexuosis, glabris, a radice ramosis, foliosis.

Folius ime cordatis, venoso-nervosis; saepe reniformibus, diffusis in petiolis longiusculis; margine dentatis saepe acuminatis. Pagina superiori opacis glabris, aut parum pilosiusculis: inferiori magis lutescentibus pilosis in nervis prominulis. Petiolis unilaterè applanatis, pilis rigidis obsitis.

Stipulis axillaribus magnis, latis, ovatis, obtusis, semiamplexicaulibus, non marcidis, sed viridibus, margine ciliatis.

Floribus majusculis viridi-flavis, in pedunculis breviusculis axillaribus, versus basin minutim stipulatis. *Petalo* infimo nigro-striato; binis lateralibus barba tenuissima adspersis, striis paucioribus; superioribus minoribus nudis. *Nectario* brevi vix producto, obtuso. *Calycis* laciniis glabris, ciliatis acuminatis. *Stigmate* deciduo in stylo longo, globoso, utrinque pilis ornato.

Capsulis magnis, ovatis, villo densissimo omnino tectis, canescentibus.

Radice diffusa.

This is common with us in newly cleared rich meadow bottoms and spreads considerably. The other is more attached to woods. Ours I never met with in any remarkable degree hairy—and at first called it *scabriuscula* from its appearance occasioned by the dispersed hair on the nerves,

&c. The colour is an opaque green on the upper side. It flowers in May and April. As usual I place the main diagnostics in contrast thus :

V. pubescens.

V. eriocarpa.

Caulis simplici erecto, apice folioso. = decumbente, ramoso, a basi folioso.

Foliis majoribus villosis-canescens. = minoribus, scabrisculis.

Stipulis axillaribus: marcidis integris, = viridibus, magnis, semiamplexicaulis villosis, minoribus. libus valde ciliatis.

Nectario abrupte inflexo, acuminato. = brevi vix producto, obtuso.

Capsulis glabris aut villosis, minoribus. = dense villosis, magnis.

26. Species. *V. Striata*. Leconte and Nobis.

Non. *V. Striata* auctorum.

V. caulescens, glaberrima. *Caulibus* erectis, simplicibus, glaberrimis, superne angulatis, inferne teretiusculis ; apice tantum foliosis ; tota planta stricta.

Foliis glaberrimis, luteo-virescentibus ; pagina superiori splendore nitentibus, nervis crassiusculis quasi plicato-striatis ; forma plerumque lanceolato-lato-rhomboides, quasi utrinque acuminatis, interdum hastato-cordatis, sinu apertissimo non rotundato ; statu juniori subcucullatis, erosodentatis.

Petiolis longitudine foliorum canaliculatis, demum cum folio reflexiusculis. *Foliis* ceterum alternis et in marginibus subciliatis. *Stipulis* axillaribus minoribus marcidis lato-ovatis, acutis, serratis.

Floribus luteis, extus saepe, praesertim in junioribus rubro tinctis, in *pedunculis* axillaribus erectis, apice minutim stipulatis, stipulis latioribus. *Petalis* subaequalibus majusculis ; infimo rotundato, striato ; lateralibus barbatis. *Nectario* non producto. *Calycis* laciniis glabris, lanceolatis, marginatis, subserratis, nervoso-striatis. *Stigmate* papillis obsito, lateribus barba alba ; in stylo breviusculo.

Capsulis minoribus glaberrimis. *Radice* fasciculari diffusa.

The erect, shining, and strict habit, the diamond shaped, strongly striate leaves, distinguish this Species easily. It grows from six to eight inches high before the stem puts out leaves, and then supports at most three, with a few axillary flowers. I have always found it growing single, though often in considerable numbers, in open woods on hill sides. Mr. Leconte first found it in our vicinity and directed my attention to it, and by continued observation I am well assured of its being a very good and constant species. Specimens have been sent from Cherokee country, agreeing

altogether with ours ; I am pretty sure it has not been observed before ; at least not distinctly. In a very few instances hairs were scattered on the nerves of the underside of young leaves ; otherwise the glabrosity is very constant. It usually flowers before the leaves have fully expanded ; middle of April and beginning of May is its time.

27. Species. *V. hastata*. Michaux.

Persoon, Synops. p. 255. n. 24. *Elliott*, p. 302. n. 13.

Michaux, p. 149. *Nuttall*, p. 150. n. 17.

Pursch, p. 174. n. 19. *Muhl.* Cat. n. 19. by Specimens.

V. caulescens ; *glabriuscula*. *Caule* simplici, summitate tantum folioso, debili, saepe attenuato-deorsum, erectiusculo, glabro, subangulato aut tereti ; interdum purpurascenti.

Foliis alternis, lanceolato-hastatis, longe acuminatis, lobis obtusis eroso-dentatis, in lanceolata parte, dentibus distantibus ; nervis ex fundo emanantibus, in pagina superiori pilis minutis adpersis ; foliis ceterum glabris pagina inferiori, autem glaucis et purpureo tinctis. *Petiolis* brevissimis. *Stipulis* axillaribus minutis, ovato-acuminatis, ciliatis.

Floribus luteis, extus purpurascens, horizontaliter in pedunculis axillaribus, filiformibus, brevioribus foliis, stipulis alternis minutissimis. *Petalo* infimo dilatato, subtrifido, basi nigro striato, striis ramosis : Lateralibus, striis paucis ; barba parcellissima : in superioribus rudimenta striarum. *Calycis* laciniis lineari-lanceolatis, longiusculis, attenuatis, subdentatis. *Nectarion* non productum. *Stigmatibus* truncato, lateribus fasciculatim piloso. *Capsulis* glabris. *Radice* horizontali, corallino-squamosa, bulbosa.

A very handsomely distinguished kind, very common here in May in shady places and among rotten wood on steep hill sides. The stem is weak and therefore often inclining. The caulis very often enters deep into the loose soil in which it grows before it expands into the root. Generally five or six inches high. The leaves of almost all our specimens, present a most perfect exemplification of an hastate leaf. I am therefore surprised, that Mr. Nuttall remarks, " they are rarely hastate." Possibly he is acquainted with a variety in which this is the case.

This species is more generally than any of the rest, affected with the *Aecidium Violae*, which frequently prevents its development.

28. Species. *V. Nuttalli*. Pursch.

Pursch, p. 174. n. 20. *Nuttall*, p. 151. n. 18.

Though entirely unacquainted with this species, found by Mr. Nuttall, to whose indefatigable labours the science is so deeply indebted, on the plains of Missouri, and the only *Viola* he observed there, I have no doubt of its being a distinct species; that gentleman's talents for correct discrimination being above praise. Botany, I conceive, owes fully as much to him for his excellent distinctions, as on account of the unsparing zeal with which he traverses our most inhospitable wilds, to augment our knowledge. It flowers in May and grows to the height of six inches; it is allied to the former by all appearance. Mr. Nuttall describes it thus:

V. caulescens, perennis, pubescens. Caule simplici, erecto, folioso.

Folius lanceolato-ovatis, integris, semiunciam latis, acutis, nervosis opacis, in petiolum longum attenuatis, margine et nervis minutim pubescentibus. Stipulis axillaribus longis, lanceolato-linearibus, integris. Folio cum petiolo 3--4 unciali, vix semiunciam lato.

Floribus minoribus, luteis, extus purpurascentibus, in pedunculis longitudine foliorum. Calycis laciniis lineari-lanceolatis acutis. Stigmate capitato, glabriusculo, erostrato.

The description seems to imply a considerable affinity to our *V. striata*.

The next species is the only American one of the subdivision *Stipulis pinnatifidis*; most of the European ones are alpine.

29. Species. *V. bicolor* vel potius *tenella*. Muhlenberg.

Elliott arvensis p. 302. n. 15. *Pursh bicolor* p. 175. n. 22.

Nuttall bicolor p. 151. n. 19. *Muhl. Cat. arvensis* n. 20. by specimens.

New-York Cat. bicolor n. 12. *Muhl. Cat. tenella* n. 23. by imperfect specimens, and confirmed by the citation in *New-York Catal. Rafinesque*.

This interesting *Viola* grows with us, along the river bottoms and in retired mountain vallies in such a manner as to leave no doubt, that it is a true native. But from my knowledge of what the German botanists call *bicolor*, I cannot believe this plant the same, and have therefore preferred the name *tenella*, which Muhlenberg gave to some young specimens, I presume. The appearance of ours is indeed very different, early in spring, when it first begins to blossom, from what it assumes at a later period. It appears in March, and is then overloaded with rotundate spatulate leaves arising from the root and low stem—and

this is nearly hid by the very large pinnatifid stipules. In time it grows very high, and but few of the radical leaves remain. The first flowers are larger in proportion than the later ones, and on short peduncles.

V. caulescens, glabriuscula. *Caule* triquetro, anguloso, erecto, simpliciusculo, folioso.

Foliis radicalibus, rotundato-spathulatis glabris, subdenticulatis: superioribus et secundariis lanceolato-spathulatis aut ovatis, breviter petiolatis. *Stipulis* oppositis, in medio et summo caule maximis, cristato-palmato-pinnatifidis, lobis multis, medio lobo longiori, ceteris lineari-oblongis obtusiusculis—in parte inferiori caulis stipulis minoribus. Omnibus margine ciliatis.

Floribus minoribus ex albo-coerulescentibus, in *pedunculis* longis angulosis sulcatis, glaberrimis axillaribus. *Petalo* infimo basi lutescenti, non barbato, venis simplicibus, paucis, coeruleis. Lateralibus exalbido-coeruleis, barba rigida alba. Superioribus nudis. *Nectario* parum postice porrecto. *Calycis* laciniis postice rotundato-auriculatis, ciliatis, antice lanceolatis. *Stylo* brevi. *Stigmate* clavato-turbinato, foramine urceolato, subpubescente. *Capsulis* ovato-globosis, glaberrimis, albis. *Radice* filiformi longa.

C. *Viola Anomala*.

The only remaining species is altogether so different in habit from the rest, that it assuredly ought to form a distinct Genus, to which probably some of the tropical ones belong. It does not grow in our vicinity; although it may be found in our mountains, as Mr. Elliott states. Mr. Nuttall has observed it in Upper Louisiana. My specimens are from Bethlehem, Pennsylvania.

30. Species. *V. concolor*. Muhlenberg. Forster.

Forster in Linn. Trans. 6. p. 309. T. 23. Pursh. p. 175. n. 21.

Nuttall p. 151. n. 20. Elliott p. 303. n. 16. Muhl. Cat. n. 22.

V. caule herbaceo erecto, undique folioso, angulato, simplici, piloso-scabro, pedali.

Foliis erectis numerosis, alternis, sessilibus, cuneato-lanceolatis, utrinque attenuatis, longe acuminatis, pubescentibus, margine irregulariter dentato, valde ciliato. *Nervis* alternis aut irregularibus. *Stipulis* axillaribus minutis subulatis.

Floribus minutissimis viridibus, in *pedunculis* axillaribus brevissimis, bi vel trifloris. *Petalis* emarginatis aequalibus,

calycem vix excedentibus. Cornu nullo. Calycis laciniis postice porrectis acutis, antice divergentibus lanceolatis.

Capsulis maximis oblongis glabris.

The habit of this plant resembles the *Triosteum* much more than any of our *Viola*e. The stem is from one to two feet high, rather bending.

I conclude with a Synoptic table of all our *Viola*e in order to facilitate their examination. Traces of a few others not sufficiently examined lead me to believe, that there are still a number of species in America undescribed.

A. VIOLAE ACAULES.

* *Floribus papilionaceis, coerulescentibus, majoribus.*

a. *Foliis multipartitis.*

1. *V. Pedata.* *Foliis* pedatis, multipartitis.
b. *Foliis* heterophyllis, i. e. integris et divisis: plus minusve pilosis.
2. *V. palmata.* *Foliis* integr. raris, palmat. plur. nullis cucull. *Stipul.* integr. *Scap.* longitud. folior. *Petalo inf.* imberbi. *Stigm.* depres. marg. *Caesp.* paucifolios.
3. *V. asarifolia.* *Foliis* integr. plurim. palmat. raris, cucullatis. *Stipul.* divisis. *Scap.* brevioribus fol. *Petalo inf.* barbato. *Stigm.* globos. immarg. *Caesp.* foliosissim.
4. *V. sagittata.* *Folius* integr. lanceol. cord; secundariis oblongis, basi sagittato-dentatis incis. *Stigm.*
5. *V. triloba* N. *Foliis* integr. alteris reniformibus planiusculis, alteris trilobis.

c. *Foliis omnibus indivisis.*

6. *V. ovata.* Pubesc. undiq. *Fol.* ovatis. in petiol. decurrentib. erectis.
7. *V. cucullata.* Glaberrim. undiq. *Fol.* cord. cucull. *Stipul.* minor. linear. *Scap.* teretibus. *Petal. inf.* rotundat. barbat. *Barb. later.* magn. cylindrica.
8. *V. obliqua.* Glaberrim. *Fol.* cord. cucull. *Stipul.* majorib. lanceol. *Scap.* quadratis. *Petal. inf.* limbo acum. carin. imberb. *Barb. later.* brev. clavato-globosa.
9. *V. villosa.* Pubesc. pag. sup. *Fol.* tenuior. planis, cord. renif. venis variegat. purpurasc. *Petal. inf.* nudo. *Calyc.* postice auricul. *Petiol.* glabr.
- + 10. *V. cordifolia.* Subpubes. pag. sup. *Fol.* crassis: sinu rotundat. clauso. non variegat. *Petal. inf.* barbato. *Calyc.* non product. *Petiol.* glabr.
- ++ 11. *V. rotundifolia.* *Florib.* lutescent. *Fol.* glabris, orbicul. sin. claus. *Petiolis* pilosis.

** *Floribus, regularioribus, albescentibus, minoribus.*

- + 12. *V. lanceolata.* *Folius* erect. angustis, lanceolat, basi attenuatis, glabris. *Petiolis* glabris marginat.
13. *V. primulaefolia.* *Foliis* erect. oblong. subcordat. obtus. in petiol. decurrent; pilociuscul. *Petiolis* subtus pilos. rubicundis.
14. *V. blanda.* *Folius* planis, terrae adpress. lato-cordatis: et orbiculat. Sinu clauso rotund. *Petiolis* longiorib. *Flor.* albis elatis in pedun. long.
- + 15. *V. clandestina.* *Folius* planis, caespitose aggregat. lato-cordat. acuminat. Sinu clauso rotund. *Petiolis* brevissimis. *Flor.* chocolatis subterr. in pedun. brev.

B. *VIOLAE CAULESCENTES.** *Stipulis axillaribus indivisis.*

a. Floribus coerulescentibus. Fol. glabriusculis.

- † 16. *V. punctata* N. pag. sup. pilis minut. Fol. cordat. crassis glandulos. punctat. Caule brevi unifloro. Nectar. longo rostr. recurvo term.
17. *V. canadensis.* Pag. sup. pilis raris. Fol. cord. longe acumin. tenuib. luteo-virid. Petalis long. angustat. Nectar. brevi. vix product.
- † 18. *V. uliginosa.* Glabriuscula. Fol. cord. acuminat. Petiolis brevib. Pedunc. filiform. longit. folior. Nectar. brevissimo non porrect.
19. *V. debilis.* Glaberrima. Fol. renifor. cordat. obtus. Petiolis longiusc. Pedunc. longiorib. foliis. Nectar. longo porrect. attenuato.
- † 20. *V. rostrata.* Glaberrima. Fol. cordat. acutis. Petiolis mediocr. Pedunc. duplo long. foliis. Nectar. longissimo rostrat. duplo coroll. exced.

b. Floribus lutescentibus. Fol. pilosiuscul. plerumque.

21. *V. ochroleuca* N. Glabriuscula. Caule folioso erecto ramos. Foliis cordatis obtus. Stipulis maxim. marg. dentibus distant. Flor. ochroleuc. barb. concolore.
22. *V. repens* N. Glabriuscula. Caule decumb. stolonifer. ramos. Foliis reniform. minor. Stipulis mag. longissime ciliatis. Flor. minorib. barb. alba.
23. *V. tripartita.* Pubescens. Caule simplic. erect. apice folios. Foliis tripartitis. Stipulis n.
24. *V. pubescens.* Villosa-pubesc. Caule simplic. erect. apice folios. Foliis lato-cord. acuminat. Stipulis marcid. villos. integr. Nectario abrupt. inflex. acuto.
25. *V. eriocarpa* N. Scabriuscul. Caule decumb. ramos. folios. Foliis cordat. et reniform. Stipulis viridib. glabr. semi-amplex. valde ciliat. Nectario obtuso vix producto.
26. *V. striata* N. Glaberrima. Caule simpl. erect. apice folios. Foliis rhomboideo-lanceolat. splendent. Stipulis minorib. lato-oratis. Nectario non producto.
27. *V. hastata.* Pag. sup. minut. pub. Caule simpl. erect. apice folios. Foliis hastatis, basi dentat. oblongo-acuminat.
- †† 28. *V. Nuttallii.* Pag. sup. minut. pub. Caule simpl. erect. apice folios. Foliis lanceolatis, ovatis, in petiolos attenuat.
29. *V. tenella.* Glabra. Stipulis cristato-pinnatifidis. Flor. albo-coeruleis.

C. *VIOLA ANOMALA.*

- † 30. *V. concolor.* Pubescens. Foliis in caule alto undique sessilibus, utrinque attenuatis. Peduncul. minutiss. trifloris. Flor. minut. viridibus.

† Signifies that I have only seen dry specimens. †† that I have never seen the plant at all. Those not marked I have examined in a fresh state.

MATHEMATICS.

ART. XI.—*On Maxima and Minima of Functions of two variable quantities; by A. M. FISHER, Prof. Math. and Nat. Phil. in Yale College.*

[From the MSS. of the Connecticut Academy.]

SOME of the most interesting as well as difficult cases of Maxima and Minima are those, in which a function of two variable quantities, x and y , is required to become the greatest or least possible, whilst another function of those quantities is supposed constant. Let the former of these functions, for the sake of brevity, be denoted by u and the latter by v . The ordinary method of solving problems of this description is by reducing the two equations, $\frac{du}{dx} dx + \frac{du}{dy} dy = 0$ and $\frac{dv}{dx} dx + \frac{dv}{dy} dy = 0$. But as both x and y are in this method made variable, it may be difficult, and in some cases impossible, to make the substitutions necessary to reduce the two foregoing equations to one.—In most cases it is the *relation* which holds between x and y , when u becomes a maximum to a given value of v , that is wanted, rather than the absolute value of either of the quantities x or y , expressed in terms of v . It might seem that if x or y were made constant, and v were allowed to vary, yet by *dividing* u by v , and making the differential of the quotient $= 0$, the required relation between x and y would be obtained. This method would indeed give the value of u when its ratio to v is the greatest or least possible to the given value of x or y ; but as the fraction $\frac{u}{v}$ will vary not only by a change in the ratio of x to y , but in that of u to v when $\frac{x}{y}$ is constant, the result obtained would be false. If, however u become some simple function of v , or vary as ϕv , when $\frac{x}{y}$ is constant, the true relation of x to y may be obtained by a method which admits of x or y being made constant. This consists in making, not $\frac{u}{v}$, but $\frac{u}{\phi v}$ a maximum or minimum. If this be done, as $\frac{u}{\phi v}$ can vary only from the

variation of x in regard to y , $d\left(\frac{u}{\phi v}\right)$ taken in respect to *one* of the variable quantities x and y , and made $=0$, will give the same relation between x and y as if v were made constant, and x and y were both allowed to vary.

This result is concisely expressed in the following

THEOREM.

If u and v be any functions of x and y , and u become any any simple function of v , (that is, vary as v^n , $\log v$, a^v , &c.) when $\frac{x}{y}$ is supposed constant, either of the equations $d\left(\frac{u}{\phi v}\right) = 0$, or $\frac{d\left(\frac{u}{\phi v}\right)}{dy} = 0$, gives u a maximum or minimum to a given value of v .

The utility of this theorem will chiefly appear in the solution of Isoperimetrical problems. If x and y be the variable quantities in the equation by which the species of any geometrical figure* is expressed, and $\frac{x}{y}$ be supposed constant, while the arbitrary constant in the equation is made to vary, the figure will continue similar to itself; and therefore if v and u be either of the quantities compared in isoperimetrical problems, ϕv will become v^n , and $u \propto v^n$. If u be the length of a curvilinear figure, or a line drawn in or about it in any given manner, and v the area of the same figure, $n = \frac{1}{2}$: if u be a solid, and v be the whole or any constant part of its superficies, $n = \frac{3}{2}$: if v and u be both solids, superficies, or lines, $n = 1$, &c.

* Those figures only are intended, which are capable of being defined by one arbitrary constant quantity, in addition to the two variable ones x and y . If the figure be a curve whose absciss and ordinate are x and y , and into the equation of which more arbitrary constant quantities than one necessarily enter, as is the case in most curves of the higher orders, different curves may be constructed to the same absciss and ordinate, merely by varying the relation of those constant quantities; so that although $\frac{x}{y}$ be supposed constant, the curve does not necessarily continue similar to itself. But the straight line, the circle, the parabolas, and the hyperbolas when referred to their asymptotes, are included in the first class, together with most of the other curves, both algebraic and transcendental, which are the most interesting in their properties, and have received particular names. The same thing is true of their superficies and solids of revolution.

The equation $\frac{d\left(\frac{u}{v^n}\right)}{dx}=0$ may, according to the common rules for maxima and minima, be thrown into the form $\frac{d\left(\frac{u^n}{v}\right)}{dx}=0$, or, if n be a fraction, and $=\frac{p}{q}$, $\frac{d\left(\frac{u^q}{v^p}\right)}{dx}=0$. The same is true of the equation $\frac{d\left(\frac{u}{v^n}\right)}{dy}=0$. Either of these forms may be used in individual cases, as is most convenient.

The following problems, which chiefly respect isoperimeters, will be sufficient to exemplify, and to shew the advantages of this method. To avoid confusion, the variable quantity x or y which is considered constant, will be put, during the operation, $=a$.

PROB. I.

Having given the solidity of a cone, to determine when the curve surface is a minimum.

In this case the height of the cone $=x$, and the radius of the base $=y$. Let the latter be constant and $=a$. The function $v=\frac{1}{3}\pi ax$, or varies as x , and $u=\pi a\sqrt{a^2+x^2}$, or varies as $\sqrt{a^2+x^2}$. Since $n=\frac{1}{3}$, $\frac{\sqrt{a^2+x^2}}{x^{\frac{1}{3}}}$, or $\frac{a^2+x^2}{x^{\frac{4}{3}}}$ $=\min$. Making the differential of this fraction $=0$, x is found $=a\sqrt{2}$, whence $\frac{x}{y}=\sqrt{2}$.

PROB. II.

Having given the whole surface of a cone, to determine when the solidity is a maximum.

In this problem, v varies as $\sqrt{a^2+x^2}+a$; and u is as x . Also $n=\frac{1}{2}$, hence $\frac{x^{\frac{1}{2}}}{\sqrt{a^2+x^2}+a}=\max$. which gives $\frac{x}{y}=2\sqrt{2}$.

PROB. III.

The whole surface of a regular prism being given, to find when the solidity is a maximum.

Let x be the height, as before, and y the radius of a circle inscribed in the base, which put const. and $=a$. If m be the number of sides, and t the tang. $\frac{180^\circ}{m}$, $2mat$ will be the sum of the areas of the ends, and $2mtx$ of those of the sides; hence $v = 2nt(a+x)$, or varies as $a+x$. Also u is as x , and $n = \frac{2}{3}$; so that $\frac{x}{(a+x)^{\frac{2}{3}}}$ or $\frac{x^{\frac{3}{2}}}{a+x} = \max.$ which gives $\frac{x}{y} = 2$. The same expression will be obtained for the maximum solidity of a cylinder, whose surface is given.

By proceeding in the same manner, it will be found that where either the slant surface, or the whole surface of a regular pyramid is given, the solidity will be a maximum when that of the inscribed cone is a maximum; that is, when the radius of the circle inscribed in the base is to the height, in the first case, as $1:\sqrt{2}$, and in the last as $1:2\sqrt{2}$.

PROB. IV.

The sum of the radius (or diameter) of the base and the height of a cone being given, to find when the solidity is a maximum, and the whole surface a minimum.

Let a denote the radius (or diameter) of the base, and x the height: then $v = a+x$, and u is as x . In this case,

$n=3$; hence $\frac{x}{(a+x)^2}$, or $\frac{x^{\frac{3}{2}}}{a+x} = \max.$ from which $\frac{x}{y} = \frac{1}{2}$;

For the superficies, which varies as $\sqrt{a^2+x^2}+a$, $n=2$;

hence $\frac{\sqrt{a^2+x^2}+a}{(a+x)^2} = \min.$ which gives $\frac{ax-x^2}{2a} = a +$

$\sqrt{a^2+x^2}$, and by reduction, $x^3 - 2ax^2 + a^2x - 4a^3 = 0$; whence the relation of x to y may be found.

If the perimeter of the vertical triangular section, or its half, the sum of the radius of the base and slant height, had been given, v would have been $= a + \sqrt{a^2+x^2}$, and for a

maximum solidity, $n=3$, hence $\frac{x^{\frac{3}{2}}}{a + \sqrt{a^2+x^2}} = \max.$ and

$$\frac{x}{y} = \frac{\sqrt{5}}{2}.$$

PROB. V.

The solidity of a cone being given, to determine when the inscribed sphere is a maximum.

A sphere inscribed in a cone will have the same radius with that of a circle inscribed in its vertical triangular section. But the radius of a circle inscribed in an isosceles triangle, if a denote half the base and x the height,

$$= \frac{ax}{a + \sqrt{a^2 + x^2}}. \text{ Since the sphere is a maximum when its}$$

radius is such, u may be taken equal to this radius, if n is made $=\frac{1}{3}$. Since then v , the solidity, varies as x , we have

$$\text{to make } \frac{ax}{a + \sqrt{a^2 + x^2}} \div x^{\frac{1}{3}}, \text{ or } \frac{x^{\frac{2}{3}}}{a + \sqrt{a^2 + x^2}} = \max. \text{ By}$$

$$\text{taking the differential coefficient} = 0, \frac{2}{3}x^{-\frac{1}{3}}(a + \sqrt{a^2 + x^2}) \\ = \frac{x^{\frac{2}{3}}}{\sqrt{a^2 + x^2}}, \text{ or by reduction, } a\sqrt{a^2 + x^2} = \frac{1}{2}x^2 - a^2,$$

whence $x = a.2\sqrt{2}$.

By substitution, the rad. of the inscribed sphere $= \frac{a}{\sqrt{2}}$, and the diameter of the sphere appears to be a third proportional to the diameter of the base, and the height of the cone. The content of the sphere is $\frac{4}{3}\pi \frac{a^3}{\sqrt{8}}$ and that of the cone is $\frac{1}{3}\pi a^2 \sqrt{8}$; hence when the sphere is a maximum, the cone is double the sphere.

The foregoing may suffice as a specimen of the application of this method to problems respecting lines of the first order.

PROB. VI.

The area of the parabola, between the curve and a double ordinate, being given, it is required to find the relation of the absciss and ordinate, when the inscribed circle is a maximum.

Let the absciss x be made constant and $=a$; put the ordinate, as usual, $=y$; then the radius of the inscribed circle is easily determined, by a figure drawn for the purpose,

to be $=y - \frac{y^2}{2a}$; or it varies as $2ay - y^2$. Let this be made $=u$; v , the area, varies as y , and $n=\frac{1}{2}$; hence $2ay^{\frac{1}{2}} - y^{\frac{3}{2}} = \text{max.}$ which gives $a=\frac{2}{3}y$, and the radius, by substitution, $=\frac{2}{3}a$.

PROB. VII.

The solidity of a paraboloid being supposed constant, to determine when the inscribed sphere is a maximum.

The radius of the inscribed sphere is the same with that of the circle inscribed in the generating parabola. u being again made $=2ay - y^2$, since $n=\frac{1}{2}$, and the solidity v varies as $y^2, \frac{2ay - y^2}{y^{\frac{1}{2}}}$ or $2ay^{\frac{3}{2}} - y^{\frac{5}{2}}$ must be made a maximum. Putting the differential coefficient $=0$, $a=2y$, or the axis of the paraboloid is equal to its double ordinate. The radius is $=\frac{2}{3}$ of the axis.

PROB. VIII.

Having given the curve superficies of a paraboloid, to find when the solid content is a maximum.

In this case it will be most convenient to consider the simple variable quantities on which the functions u and v depend as being the absciss and parameter. Making the parameter constant and $=a$, the surface v will be as $a^2 + 4ax |^{\frac{3}{2}} - a^3$; the solidity u ($=\frac{1}{3}\pi ax^2$) is as x^2 and $n=\frac{2}{3}$. Hence $\frac{u}{v^{\frac{2}{3}}}$ or $\frac{u^{\frac{3}{2}}}{v}$ that is, $\frac{x^3}{a^2 + 4ax |^{\frac{3}{2}} - a^3} = \text{max.}$ whence $x^2 - \frac{15}{4}ax + 3a^2 = 0$, or $x = \frac{8a}{5 \pm \sqrt{\frac{11}{3}}}$.

If we had taken the other formula $\frac{d\left(\frac{u^{\frac{3}{2}}}{v}\right)}{dy} = 0$, making the absciss constant and $=a$, u is as y , and v as $\frac{4ay + y^2 |^{\frac{3}{2}} - y^3}{y}$;

n , as before $=\frac{2}{3}$; hence $4ay + y^2 |^{\frac{3}{2}} y - \frac{5}{3} - y^{\frac{4}{3}} = \text{max.}$ which gives $a^2 - \frac{1}{4}ya + 3y^2 = 0$. This equation exhibits the same relation between the absciss and parameter with the last.

If we attempt to solve this problem in the usual way, by making $\frac{4xy+y^2}{y}^{\frac{2}{3}}-y^3$ constant and $=b$, we obtain, after a tedious process, two equations between x and y , one of which is a quadratic in regard to y , and the other a cubic in regard both to x and y . This appears to be the simplest form to which the solution, if it may be called such, can be brought, and it is only by an artifice not very obvious, that even this degree of simplicity can be attained.

The converse of this problem may, however, be readily solved in the usual manner, in consequence of the simplicity of the expression for the solidity. If with a given solidity, the superficies be required to become a minimum, since the solidity varies as x^2y , (x being as before, the absciss, and y the parameter,) put $x^2y=b^2$; then $x=\frac{b}{y^{\frac{1}{2}}}$, and by substituting in the expression for the surface, $4by^{\frac{1}{2}}+y^2$, $y^{\frac{3}{2}}-y^2$

$=\min.$, which by putting z in the place of $y^{\frac{1}{2}}$, affords the following equation: $3z^2-\frac{15}{4}zb+b^2=0$. This equation is of the same form with those already obtained, and it is evident that the same relation ought to exist between z ($=y^{\frac{1}{2}}$) and b , ($=xy^{\frac{1}{2}}$), as between y and x .

But the method adopted above is equally applicable to cases when both the functions u and v are complex, as will appear in the following problems.

PROB. IX.

It is required to determine when a parabola of given length will describe the greatest possible superficies by its revolution about its absciss.

In this example, v denoting the length and u the superficies, (the parameter being made constant and $=2a$), $\frac{u}{v^2}=\max.$ or, which is the same thing, $vu^{-\frac{1}{2}}=\min.$ Substituting the normal x ($=\sqrt{y^2+a^2}$), in place of y in the ordinary expressions for the length and superficies, the former will be found to vary as $x\sqrt{x^2-a^2}+a^2$ h.l. $\frac{x+\sqrt{x^2-a^2}}{a}$;

and the latter as $x^3 - a^3$. Hence we have to make
 $\left(x\sqrt{x^3 - a^3} + a^3 \text{ h.l. } \frac{x + \sqrt{x^3 - a^3}}{a} \right) (x^3 - a^3)^{-\frac{1}{2}} = \text{min.}$
 which gives the following equation, expressing the relation
 between x and a : $\frac{x^3 - a^3}{\sqrt{x^3 - a^3}} = 3a^2 \text{ h.l. } \frac{x + \sqrt{x^3 - a^3}}{a}$; or by
 restoring y ; $y^3 + a^3 = 3a^2 y \text{ h.l. } \frac{y + \sqrt{y^3 + a^3}}{a}$.

PROB. X.

Having given the length of a parabola, it is required to find when the area contained by it and a double ordinate is a maximum.

Here v (putting the double ordinate $= 2y$, and the parameter $= 2a$) $= \frac{y}{a} \sqrt{y^2 + a^2} + a \text{ h.l. } \frac{y + \sqrt{y^2 + a^2}}{a}$, and $u = \frac{2y^3}{3a}$, or varies as y^3 . Hence, as $\frac{u}{v^2} = \text{max.}$, or $\frac{v}{u^{\frac{1}{2}}} = \text{min.}$,
 $y^{-\frac{1}{2}} \sqrt{y^2 + a^2} + a^2 y^{-\frac{3}{2}} \text{ h.l. } \frac{y + \sqrt{y^2 + a^2}}{a} = \text{min.}$ whence
 $y \sqrt{y^2 + a^2} = 3a^2 \text{ h.l. } \frac{y + \sqrt{y^2 + a^2}}{a}$. This equation will be more conveniently computed by approximation, if a be assumed $= 1$. Or if ϕ be the arc, whose $\cot. = \frac{y}{a}$, the value of y may be approximated by means of tables of natural and logarithmic sines, from the following equation: $\frac{\cot. \phi}{\sin. \phi} = 3 \text{ h.l. } \cot. \frac{1}{2} \phi$. Or if $\cot.$ denote a tabular artificial cotangent, and m the modulus of the common system, $\frac{\cot. \phi}{\sin. \phi} = \frac{3}{m} (\cot. \frac{1}{2} \phi - 10)$.

Cor. Since z , (the length of the curve,) $= \frac{y}{a} \sqrt{y^2 + a^2} + a \text{ h.l. } \frac{y + \sqrt{y^2 + a^2}}{a}$, by substitution, $z = \frac{4}{3} \left(\frac{y^4}{a^3} + y^2 \right)^{\frac{1}{2}} = \frac{4}{3} \sqrt{4x^2 + y^2}$, (x being the absciss,) when, with a given length, it contains the greatest area possible. The subtangent $= 2x$; hence the length of the half of the curve, which lies above the axis, is $\frac{2}{3}$ that of the tangent.

PROB. XI.

It is required to suspend a flexible chain, of given length, in such a manner that the area, included by it, and the straight line joining its extremities may be the greatest possible.

The area of this curve, contained between the absciss x , the ordinate y and the curve z , is $=(a+x)y-az$. The equation of the curve is $z^2=2ax+x^2$; hence $a+x=\sqrt{a^2+z^2}$, and the area is $\sqrt{a^2+z^2} \cdot y-az$ ($=u$.) If the area were supposed constant, a must be made to vary; but

by making $\frac{u}{x}$ a maximum, or $\frac{y\sqrt{a^2+z^2}}{x^2}-\frac{a}{x}=\max.$ a may

be supposed constant. We might proceed to exterminate y , and to find the differential with one variable z , as in the preceding cases; but in the present case, it will be most convenient to retain y in finding the differential, and to exterminate it afterwards. The differential equation, consid-

sidering y and z as both variable, is $-\frac{y(2a^2+z^2)dz}{z^3\sqrt{a^2+z^2}}+$

$\frac{\sqrt{a^2+z^2}.dy}{z^2}+\frac{adz}{z^2}=0$. But $dy=\frac{adz}{\sqrt{a^2+z^2}}$; hence by

substitution, (putting for y its equal $\text{ch.l.} \frac{z+\sqrt{a^2+z^2}}{a}$),

$\frac{2a^2+z^2}{\sqrt{a^2+z^2}} \text{ h.l.} \frac{z+\sqrt{a^2+z^2}}{a}=2z$. This equation may be

thrown into the following form: $\frac{\frac{2a^2}{z^2}+1}{\sqrt{\frac{a^2}{z^2}+1}} \cdot \text{h.l.} \frac{1+\sqrt{\frac{a^2}{z^2}+1}}{\frac{a}{z}}=2$.

Now $\frac{a}{z}=\frac{dy}{dx}=\text{tang.}$ of the angle ϕ contained by a line drawn touching the upper extremity of the curve and the absciss produced; and $\sqrt{\frac{a^2}{z^2}+1}=\text{sec.}$ of the same angle. Putting

this secant $=s$, we have by substitution, $\frac{2s^2-1}{s} \cdot \text{h.l.} \left(\frac{s+1}{\sqrt{s^2-1}} \right)$

$=2$. But $\text{h.l.} \left(\frac{s+1}{\sqrt{s^2-1}} \right) = \frac{1}{2} \text{h.l.} \left(\frac{s+1}{s-1} \right)$; hence $\frac{2s^2-1}{s} \cdot \text{h.l.}$

$\frac{s+1}{s-1}=4$. This equation may be easily approximated: but if a table of sines and tangents be preferred, it may be transformed into the following: $(\sec. \varphi - \frac{1}{2} \cos. \varphi) (\cot. \frac{1}{2} \varphi - 10) = m$. From either of these equations, φ appears to be $= 22^\circ 42' 57''$. Hence the chain, when it includes a maximum area, must be so placed that the tangents to its two extremities shall make an angle of $45^\circ 25' 54''$. And since $y = a. \text{h.l.} \frac{z + \sqrt{a^2 + z^2}}{a}$, to find y in terms of z , first put $z=1$, and $y = a. \text{h.l.} \frac{1 + \sqrt{1+a^2}}{a}$. When $z=1$, $a (=z. \tan. \varphi)$, because Vince's Flux. p. 38. subt. $= \frac{xy}{a}$ $= 4186338$; hence y will be found $= 773946$. Since y varies as z in similar figures, whatever z may be, the distance of the points of suspension must be to the length of the chain as 773946 to 1 .

PROB. XII.

To determine the form of a cup, which, with a given thickness and weight of materials, shall have the greatest possible capacity.

It is easily shewn that this cup must be some portion of a hollow sphere, terminated at the top by a plane. If the thickness be regarded as inconsiderable, with a given superficies, we have to make the solid content a maximum. Let y be the ordinate of the generating circular segment, and let the absciss x be made constant, and $=a$. Then the radius of the sphere $= \frac{x^2 + a^2}{2a}$, the solidity is as $3x^2 + a^2$, the superficies as $x^2 + a^2$, and since $n = \frac{2}{3}$, $\frac{(3x^2 + a^2)^{\frac{2}{3}}}{x^2 + a^2} = \text{max.}$ from which $x=a$; or the cup must be hemispherical.

PROB. XIII.

To determine the same thing, when the thickness of the vessel (supposed in the form of a spherical segment) is inconsiderable at the bottom, and varies in such a manner as

to render the vessel, so far as the pressure of a contained fluid is concerned, equally strong throughout.

The thickness, to verify this condition, must be every where as the distance from the top. If the ordinate be x , and the height a , as before, it is shewn without difficulty that the solid content of the vessel, or the space contained between the interior and exterior surfaces (putting t = thickness at bottom) is equal to $\pi ta \times$ rad. of the sphere. Now while the capacity of the vessel is supposed to continue similar to itself by making $\frac{x}{y}$ constant, t the thickness of the bottom, must be supposed constant, otherwise v , the space included between the two surfaces, will be a function of an arbitrary variable quantity, which does not enter into u , the capacity. But if t be constant, while the capacity varies so as to continue similar to itself, the thickness at any other point, which continues similarly situated with regard to the whole surface, will continue constant. Therefore while u continues similar to itself in all its dimensions, v varies only in two dimensions; so that $n = \frac{2}{3}$, as before, and the same result is obtained as in the last problem. The same would be true, should we suppose the thickness from the bottom upwards, to vary as any other function of two dimensions, into which x and y alone enter.

Schol. In two cases, the vessel, of which the outside is spherical, and the thickness every where as the distance from the top, will have its interior surface spherical. When it is a hemisphere, the interior surface will be a hemisphere of the *same radius*, and the thickness, estimated perpendicularly to the horizon, will be every where the same. When it is an entire sphere, the inner surface will also be an entire sphere, of a radius less than the exterior surface by half the thickness of the bottom; and the sum of the two thicknesses, contained in any one vertical line, and estimated in the direction of that line, will be every where the same.

PROB. XIV.

Having given the area of a circular sector, to find when its chord is a maximum.

In this case let the radius and half the arc be the simple variable quantities x and y : make the radius constant and $=a$; then the chord $=2a \sin y$, or varies as $\sin y$, and the sector varies as y . Since $n=2$, the fraction to be made a maximum is $\frac{y}{\sin^2 y}$. By taking the differential, $\sin y dy = 2y \cdot d(\sin y)$. But $d(\sin y) = \frac{\cos y dy}{a}$; hence by substitution and reduction, $\frac{a \sin y}{\cos y} = 2y$. Or $\tan y$, to rad. $a=2y$. Hence $y=66^\circ 46' 54'' \frac{1}{4}$.

PROB. XV.

Having given the area of a circular sector, which is suspended by its vertex, and vibrates in its own plane, it is required to determine when the time of vibration is a minimum.

The notation remaining as before, the distance of the centre of gravity from the vertex of the sector $= \frac{2a \sin y}{3y}$; and that of the centre of oscillation is found without difficulty to be $= \frac{3ay}{4 \sin y}$. The time of vibration varies as the square root of the line $\frac{3ay}{4 \sin y}$, or as $\sqrt{\frac{y}{\sin y}}$. If the function u denote the time, and v the area of the sector, when $\frac{x}{y}$ is supposed constant, $u \propto v^{\frac{1}{2}}$, or $u = \frac{1}{2}$; hence $\frac{\sqrt{\frac{y}{\sin y}}}{y^{\frac{1}{2}}}$, or $\frac{y}{\sin^2 y} =$ min. which leads to the same result as in the last problem.

It will be unnecessary to add more examples in illustration of this method. If it furnishes no new instrument to the adept in Analysis, it may still perhaps be regarded with some interest by those who are desirous of giving the greatest possible extent to the ordinary method of obtaining maxima and minima, in consequence of not enjoying the opportunity of becoming familiar with all the refinements of the modern calculus.

Yale College, August, 1818.

PHYSICS AND CHEMISTRY, MECHANICS AND THE
ARTS.

ART. XII.—*Correspondence between ROBERT HARE, M. D. Professor of Chemistry &c. in the Medical Department of the University of Pennsylvania, and the Editor, on the subject of DR. HARE'S Calorimotor and Deflagrator, and the phenomena produced by them.*

INTRODUCTORY REMARKS.

It may be remembered, by the readers of this Journal, that in the letter alluded to below by Dr. Hare, (see p. 201, vol. 4.) the editor, after relating the experiments which he had performed with the Deflagrator, states that he had discovered a very unexpected and surprising incompatibility between the Deflagrator and the common galvanic battery.—On connecting an instrument of the latter description, consisting of six hundred and twenty pairs, of four and six inch plates, in full activity, with the Deflagrator of eighty coils also in great power, both instruments were completely paralysed; this was constantly the fact however they were connected, but, on being separated, each instrument instantly recovered its energy. Dr. Hare's first letter relates to this subject.

LETTER 1.—From Dr. Hare, on the incompatibility of the above instruments, and the common galvanic Batteries when used in connexion.

Philadelphia, November 5, 1821.

My Dear Sir,

I HAVE received your letter on the Deflagrator which I sent you last spring. I fear you have done me more than justice.*

* See No I. vol. IV. of this Journal, for October last.

I should not be surprised, if the coils when insulated by the glass jars, should form a circuit with your other apparatus, better, than when immersed in the troughs. You will observe that when recently lifted from out of the acid, the air insulates the coils; while the pieces of wood used to keep the copper from touching the Zinc, act to a certain extent like the moistened cloth in Volta's original pile.—When in this situation, the poles will affect an electrometer much more powerfully, than when the coils are immersed; though in one case, the igniting power will burn a platina wire of one eighth of an inch in thickness, in the other it will not burn Dutch gold leaf.

In my memoir, on a new theory of galvanism, published in your Journal is the following passage: "According to my view, caloric and electricity may be distinguished by the following characteristics. The former permeates all matter more or less, though with very different degrees of facility. It radiates through air with immeasurable celerity, and distributing itself through the interior of bodies, communicates a reciprocally repellent power, to atoms, but not to masses.* Electricity does not radiate in or through any matter, and while it pervades some bodies, as metals, with almost infinite velocity; by others it is so far from being conducted, that it can pass through them only by a fracture or perforation. Distributing itself of choice over surfaces only,† it causes reaction between masses, but not between the particles of the same mass. The disposition of the last mentioned principle (electricity) to get off by neighbouring conductors, and of the other (caloric) to combine with the adjoining matter or to escape by radiation, would prevent them from being collected at the positive pole, if not in combination with each other. Were it not for a modification of their properties consequent to some such union, they could not, in piles of thousands of pairs, be carried forwards through the open air and moisture, the

* It cannot be pretended that electricity expands the gold leaves of an Electrometer when it renders them divergent, or that caloric causes any repulsion between the ignited masses which it expands.

† It is only when under a great restraint, that electricity enters the pores of metallic wires and deflagrates them. If it exist otherwise than on the surfaces of conductors, why does a hollow metallic sphere take as large a charge as a solid one.

one so well calculated to conduct away electricity, the other so favourable to the radiation of caloric."

Pursuing the same subject in a subsequent memoir, also published in your Journal I thus expressed myself, "As yet no adequate reasons have been given why, in operating with the pile, it is not necessary, as in the process of Van Marum and Wollaston, to enclose the wires in glass or sealing wax, in order to make the electricity emanate from a point within a conducting fluid. The absence of this necessity is accounted for, according to my hypothesis by the indisposition which the electric fluid has to quit the caloric in union with it, and the almost absolute incapacity which caloric has to pass through fluids unless by circulation. I conceive that in galvanic combinations, electro-caloric may circulate through the fluids from the positive to the negative surface, and through the metal from the negative to the positive. In the one case caloric subdues the disposition which electricity has to diffuse itself through fluids, and carries it into circulation. In the other, as metals are excellent conductors of caloric, the prodigious power which electricity has to pervade them agreeably to any attractions which it may exercise operates almost without restraint. This is fully exemplified in my galvanic deflagrator, where eighty pairs are suspended in two recipients, forty successively in each, and yet decompose potash with the utmost rapidity, and produce an almost intolerable sensation when excited only by fresh river water. I have already observed that the reason why galvanic apparatus composed of pairs consisting each of one copper and one zinc plate, have not acted well without insulation; was because electro-caloric could retrocede in the negative, as well as advance in the positive direction."

Agreeably to these views, in order to prevent the escape of the electricity put into motion by the series, the caloric must bear a certain proportion to it. It is to be inferred, consistently with the same hypothesis, that this proportion did not exist in the series which you connected with the deflagrator. The fluid presented to the latter had too much electricity in it; and hence instead of passing into circulation, escaped. When the coils were suspended in air, this escape was less favored than when they were covered by the diluted acid.

Faithfully Yours.

ROBERT HARE.

LETTER II.—From Dr. Hare, on the peculiar and comparative effects of the Calorimotor and Deflagrator. Also, an account of AN IMPROVED AND ENLARGED DEFLAGRATOR, and of some new experiments performed by means of this instrument.

Philadelphia, March 5, 1822.

My Dear Sir,

In reply to your enquiries on the subject of the Calorimotor, and the expediency of employing one during your lectures, it may be proper to mention, that the phenomena produced by it are more agreeable to the eye and therefore more popular, than any which can be performed without greater difficulty. By the time the Calorimotor is completely immersed in the acid solution, the wire in the forceps is rendered white hot, and takes fire, emitting the most brilliant sparks. In the interim, an explosion usually gives notice of the extrication of hydrogen in a quantity adequate to reach the burning wire. Immediately after the explosion, the hydrogen is reproduced with less intermixture of air, and rekindles, corruscating from among the forty interstices, and passing from one side of the machine to the other in opposite directions, and at various times, so that the combinations are innumerable. The flame assumes various hues, from the solution of more or less of the metals, and a blazing froth, rolls over the sides of the recipient. When the calorimotor is withdrawn from the acid solution, the surface appears for many seconds like a sheet of flaming foam.

I refer you to the last paragraph of my memoir on the Deflagrator, for some results obtained by calorimotors, of different sizes, which I deem to be scientifically important.*

* The heat evolved by one galvanic pair has been found by the experiments which I instituted, to increase in quantity, but to diminish in intensity, as the size of the surface may be enlarged. A pair containing about fifty square feet of each metal, will not fuse platina, nor deflagrate iron, however small may be the wire employed; for the heat produced in metallic wires is not improved by a reduction in their size beyond a certain point. Yet the metals abovementioned, are easily fused or deflagrated by small pairs, which

With respect to the comparative powers of concentric coils, of copper and zinc and of plates of those metals alternating; if only a few pairs are to be employed, I believe it a matter of indifference which construction we adopt. I have however, found to my cost that it is far from being so when the series is numerous. Last summer I constructed an apparatus of one hundred pairs, each containing six alternated plates, three of each metal. On trial, it proved much less powerful than the Deflagrator sent to you, though the zinc surface in each pair, was one seventh larger, and the number of the series one fourth more extensive. The exposure to each other, of the copper and zinc plates terminating the different pairs, struck me as disadvantageous. I therefore, removed the external zinc plate in each, so that the pair afterwards, consisted severally of three copper and two zinc plates, and were bounded by copper towards both poles. There was some comparative gain by this change, as the power was not lessened in proportion to the diminution of zinc surface. Still the result was unsatisfactory. I then had some boxes made with partitions of glass, to be interposed between the pairs of the series. These were employed as is usual with galvanic troughs, made with partitions, excepting the deficiency of bottoms, and their being suspended to the beams, so as to be simultaneously immersed with the galvanic surfaces which they were intended to insulate. The power of the series was not amended by this contrivance. It had often occurred to me, that surrounding the zinc by Copper, might be an indispensable feature in the arrangement of my Deflagrator of coils. In order to test the correctness of this surmise, I proceeded to form an ap-

would have no perceptible influence on masses that might be sensibly ignited by larger pairs. These characteristics were fully demonstrated, not only by my own apparatus, but by those constructed by Messrs. Wetherill and Peale, and which were larger, but less capable of exciting intense ignition. Mr. Peale's apparatus contained nearly seventy square feet, Mr. Wetherill's nearly one hundred, in the form of concentric coils, yet neither could produce a heat above redness on the smallest wires. At my suggestion, Mr. Peale separated the two surfaces in his coils into four alternating, constituting two galvanic pairs in one recipient. Iron wire was then easily burned and platina fused by it. These facts, together with the incapacity of the calorific fluid extricated by the calorimotor to permeate charcoal, next to metals the best electrical conductor, must sanction the position I assigned to it as being in the opposite extreme from the columns of De Luc and Zamboni. For as in these, the phenomena are such as are characteristic of pure electricity, so in one very large galvanic pair, they almost exclusively demonstrate the agency of pure caloric.

paratus of pairs, each consisting of a case of copper, containing one zinc plate of seven inches by three, the size used, in the apparatus above described. (See the plate at the end.) In these pairs, as in those contrived by Wollaston, the edges of the zinc were supported by grooved pieces of wood passing between them and the copper. There was, however, this apparently slight, but really important difference, that the cases employed by me, were open at top and bottom, instead of exposing the edges of the zinc laterally, as in Wollaston's. One hundred galvanic pairs, thus made, were suspended to two beams, each holding fifty. Between each case, a piece of pasteboard soaked in shell lac varnish, was intersposed; so that the whole constituted a compact mass, into which a fluid could not enter, unless through the interstices purposely preserved between the copper and zinc. The phenomena produced by this apparatus, on immersion, were upon the whole more interesting than those produced by my original deflagrator; especially in the length of the jet between the poles, and the power of permeating charcoal. Yet the apparatus was comprised within one eighth of the space, and is not (in oxidizable superficies) of half the extent.

Having added three more beams, of fifty pairs each, to my apparatus, I found the power increased fully in the ratio of the number. You know that my eyes are naturally very strong. The light produced by the compound blowpipe,* though I operated without glasses, only dazzled them for a time, and hitherto I had felt no other inconvenience from my galvanic experiments. Rendered thus bold by previous immunity, I still dispensed with the annoyance of spectacles. In consequence, my eyes, after operating with the last mentioned series of two hundred and fifty, were on the following day so much inflamed, as to be blood shot, and painfully susceptible of the day light. The judicious application of twenty leeches to each of the eye-lids, pursuant to the advice of my friend, Dr. Dewees, afforded me surprising relief, and my eyes are now well enough to finish this letter, though a few days since when I began it, I was under the necessity of employing an amanuensis.

By this series of 250, Barytes was deflagrated; and the Platina which supported it destroyed like pasteboard before

* Since called Hydro-oxygen Blowpipe.

an incandescent iron. A platina wire three sixteenths of an inch in thickness, was made to flow like water. Iron of like dimensions burned explosively. When the experiments were repeated before my class of more than three hundred pupils, and many visitors, there were very few who could bear the light with the naked eye.

Much attention was excited by the deflagration of a stream of Mercury. This was accomplished in the following way. A wire proceeding from one pole of the deflagrator, was introduced into some mercury held in a glass basin; and another wire proceeding from the other pole, into some mercury in another vessel, having a capillary orifice which might be closed by the finger or a stopple. This last mentioned vessel with the mercury running from it was supported at such a height above the surface of the mercury in the glass basin, as to permit the discharge to take place through the metallic stream just as the galvanic surfaces were subjected to the acid. The mercury deflagrated explosively.

The experiments may be varied, by causing the stream of mercury to fall on iron filings, or card teeth.

When the phenomena of a series of 250 pairs of 7 inches by 3, are such as I have described what would be the power of a deflagrator with plates, as large as Children's, and as numerous as Davy's?

Probably the most useful mode of applying such instruments to analysis, would be to expose substances to the discharge in vacuo on carbon. I observed that after iron and charcoal were ignited between the poles during a few seconds, under an exhausted receiver, on admitting the air, a flash took place, and a yellowish red fume appeared which condensed on the glass. It would seem the iron was volatilized,* and that the admission of air oxidized the vapour.

A deflagrator of 250 or 300 pairs is found to produce torture when applied for a short time to the back of the hand, and it is difficult for the sufferer to believe, that his skin has not been cauterized. One of my pupils showed me a slight excoriation, which he considered as arising from it, on the spot where the positive pole had touched him. Between the excitement of acid, and water, the difference of power in affecting the flesh, is far less than with metals,

* And possibly the carbon too? Ed.

charcoal, or potash. Upon these substances, the excitement by water has no influence, but to the sensation is painful, though it may be borne longer, than when acid is used. Neither is the shock greater, in any sensible degree, at the moment of immersion, than afterwards. The effect upon the electrometer, is at least as great, with water. as with acid. Immediately over any of the most turgid veins, where the skin is tender, as on the back of the hand, will be found the greatest sensibility. The positive pole, is most capable of producing pain. This I had frequent opportunities of ascertaining, by the observations of those who, not knowing how to distinguish it from the negative pole, could not have been biassed in their opinion. Upon a common gold leaf electrometer, a deflagrator of 300 pairs will have no influence. I have constructed one by means of a bottle, a single slip of gold leaf, and a knob at right angles to it, supported by a screw, so as to be easily moved nearer to or further from the leaf. The wire from which the latter is suspended, passes through a cork in the neck of the bottle. The screw enters through a nut, cemented into a hole drilled on one side. When the wire which supports the leaf, is fastened to one of the poles, every time the screw is touched by the other, the leaf will strike the ball provided the distance be very small, perhaps not greater than the tenth of an inch. This result was obtained at a greater distance when the coils had been recently withdrawn from the acid, than when they are covered by it. I have known a piece of dry sealing wax, as big as a chesnut, without friction, to affect this electrometer as much as my largest deflagrator.

A magnetic needle was very powerfully disturbed by the deflagrator, under all its forms. The celerity, with which the galvanic surfaces may be immersed in, or withdrawn from the acid, contributes much to economy, and to the ease of the operator in galvano-magnetic enquiries.

The prevalent notion, that the intense light and heat produced by galvanic action, are results secondary to electricity, the presence of which is at times only indirectly discoverable, the more surprises me; since it does not in the smallest degree, elucidate the primary operation, by which this principle is alleged to be evolved. According to some philosophers, the contact of the metals alone, according to others this contact accompanied by their solution, evolves electricity in quantity sufficient to extricate heat

and light from a wire made the medium of transmission. They do not however, explain why the electricity does not, according to all its known habitudes, rapidly escape through the water, as fast as generated, instead of proceeding from one plate to another, in order to pass off through a second portion of the same fluid. Would it not be more philosophical, to suppose that the heat and light result *directly* from the causes supposed to produce them *indirectly*; especially, as we actually see *them* in a high degree of intensity, while the characteristic agency of the principle, by which they are supposed to be produced, is but feebly perceived, or imperfectly demonstrated? In the case of a single galvanic pair, electricity has never been alleged discoverable, unless by the questionable assistance of condensers.

Besides, without supposing caloric and light to circulate from the apparatus through the conjunctive wire, those who consider them as material, will find it impossible to account for the durability of the ignition. If it be supposed that these principles are extricated from the metal, only by electricity passing through it, their repeated or incessant expenditure, ought sooner or later to exhaust the metal, and render it incapable of further ignition.

On this subject, especially, as connected with magnetism, and mechanical electricity, you shall hear from me again.

LETTER III.—From the Editor.—On the incompatibility of the Voltaic Batteries and the instruments of Dr. Hare when used in connexion.

TO PROFESSOR HARE.

Yale-College, New-Haven, April 9th, 1822.

My dear Sir,

In my letter of Oct. 23d, 1821, addressed to you (Vol. 4, p. 203 of this Journal) respecting the experiments which I had performed with your deflagrator, I mentioned the incompatibility which I discovered to exist between your apparatus and the common galvanic battery. I have recently repeated these experiments with some additions and variations which I now take the liberty of stating to you.

In the trials made last October with your instrument, the coils were used without glasses, being immersed in a fluid, contained in a common recipient. In those recently performed, and which I shall now relate, the metallic coils were individually insulated, for they were immersed in the cylindrical glasses belonging to the apparatus, it being previously connected with the common galvanic battery by its proper poles as described in my former letter; the effects were however in no respect different from those before observed, so that the insulation of the coils appears to be a fact of no importance. In the first experiment the deflagrator being connected by its proper poles with a galvanic battery of 300 pairs of four inch plates cemented in mahogany troughs, and interposed between the two rows of the deflagrator, of forty coils each, lost all its power, and the effect produced was very much inferior to that of the battery alone, for in fact the spark was hardly perceptible.

The chemical or decomposing powers of the common galvanic battery, were also found to be suspended by the connexion—for the 300 pairs which usually decompose water, salts, &c. with decisive energy, now produced in water scarcely a bubble of gas, and hardly affected dilute infusion of purple cabbage. The power of giving a shock was also destroyed by the connexion.

When the coils were raised out of the fluid and suspended only in the air, they acted as conductors of the power of the common battery, which now produced *all* its appropriate effects, although, even in this case, the galvanic influence appeared somewhat diminished, which would of course arise both from the *extent* of the conducting surface, and from the fact that a part of the substance, namely, the wedges of moist wood, interposed between the metals was an imperfect conductor.

These experiments (including the former trials) were made with different combinations from 620 pairs down to 20, and were attended, uniformly with the same result; viz. an almost entire suspension of the power of both instruments.

In one of the experiments, twenty-five pairs of the zinc and copper plates, six inches square, connected by slips of copper and suspended from a beam of wood were immersed in a trough without partitions filled with an acid liquor, and the connexion being formed with the deflagrator, the

power of the latter instrument was found to be completely destroyed—a similar result was obtained by a battery consisting of fifty *triads* of plates two inches square, each zinc surface being coated by a copper plate after the manner of Dr. Wollaston—the object of this arrangement, was, to ascertain, whether a battery, in which the arrangement of metals was similar, to that in the deflagrator, would produce a result in any respect different from that of the common battery; the effect however was precisely the same. In most of the experiments the connexion of the poles was occasionally reversed. This circumstance however made no difference in the result; a feeble spark was obtained as before. Every thing tended to countenance the opinion *that the interposition of the common galvanic battery operated simply as an impediment—that it was completely inert in relation to the deflagrator, and the deflagrator in relation to it, —that the power of neither would pass through the other, and consequently that each was to be regarded, with respect to the other, simply as so much interposed matter, constituting a conductor more or less, imperfect.* To bring this conjecture to a decision, the number of interposed plates was constantly diminished, until the connexion was formed by no more than twenty pairs. In this state of things, the power of the deflagrator passed freely, although somewhat diminished. The connexion was now formed with smaller and smaller numbers of pairs; the activity of the deflagrator in the mean time rapidly increased, until the moment, when only one pair was employed (this pair being, however, like the others, immersed in an acid fluid,*) then there was no perceptible impediment, and the effect was as brilliant as when nothing was interposed.

I have thought these curious facts worthy of being preserved, and I have addressed them to you with the hope that you will be able to throw some light upon this singular anomaly, which to me appears to be incapable of explanation, in consistency with the received theories of galvanism. Hoping that you will, through the medium of this journal, favour the public with your views upon this subject.

I remain with very great respect,

Your friend and servant,

B. SILLIMAN.

* When this *one* pair was surrounded by air alone the power of the deflagrator passed freely as might have been expected.

LETTER IV.—From Dr. Hare to the Editor in reply to the preceding letter.

PHILADELPHIA, May 25, 1822.

My Dear Sir,

IN a former letter you mentioned, that you had found the power of the galvanic deflagrator, when its coils were subjected to acid in troughs without partitions, incompatible with the power of other voltaic series, of the usual forms; that when associated with them in one circuit, it could neither give, nor receive excitement. You now inform me, that this incompatibility is not lessened when the coils are insulated by glass jars.* It follows, that electrical insulation has less influence on the action of this instrument, than I had supposed, and it of course confirms my idea, that the deflagrating power is not purely electrical.

It cannot be doubted, notwithstanding your experiments, that there is a principle of action, common to the various apparatus which you employed, and all other galvanic combinations. The effect of this principle of action however, varies widely according to the number of the series, the size of the members severally, and the energy of the agents interposed. Towards the different extremes of these varieties are De Luc's Column apparently producing pure electricity, and one large galvanic pair, or calorimotor of two surfaces, producing, in appearance, only pure caloric. At different points between these, are the series of Davy and Children; the one gigantic in size, the other in number. In the deflagrator we have another variety, which, with respect to size and number, is susceptible of endless variation.

It must be evident that no galvanic instrument, where a fluid is employed, could aid, or be aided by, the columns of De Luc or Zamboni. Nor could the influence of either be transmitted by the other. A calorimotor could not aid Davy's great series; nor could the latter, act through a calorimotor. Taking it for granted that there can be no oversight in your experiments, this incompatibility of ex-

* See Memoir and engraving in this Journal for February, 1821. Also, in Tilloch's magazine, and the Annals of Philosophy, for April and May, 1821, VOL. V.—No. 1.

citing power must exist to a great degree, under circumstances where it could hardly have been anticipated.

Were the fluid evolved by galvanic action purely electric, the effect of batteries of different sizes, when united in one circuit, ought not to be less than would be produced if the whole of the pairs were of the smaller size. But if on the contrary, we suppose the voltaic fluid compounded of Caloric, light and electricity, so obviously collateral products of galvanic action; the ordinary voltaic series, employed in your experiments, may owe its efficacy more to electricity—and the deflagrator more to caloric. The peculiar potency of both may be arrested when they are joined, by the incompetency of either series to convey any other compound than that which it generates. The supply of caloric from the ordinary series may be too small, that of electricity too large; and vice versa. It might be expected that each would supply the deficiency of the other; but it is well known that many principles will combine only when they are nascent. The power of my large deflagrator (described in letter II.) in producing decomposition, is certainly very disproportional to its power of evolving heat and light. When wires proceeding from the poles were placed very near each other under water, it was rapidly decomposed; but when severally introduced into the open ends of an inverted syphon, filled with that fluid, little action took place —: Potash is deflagrated and the rosy hue of the flame indicates a decomposition. Still however the volatilization of the whole mass, and intense ignition of the metallic support, prove that the calorific influence is greatly and peculiarly predominant.

I fear that in my essays on galvanic theory, the possible activity of light, has been too much overlooked. The corpuscular changes which have been traced to the distinctive energies of this principle, are so few that we have all been in the habit, erroneously perhaps, of viewing it as an inert product in those changes, effected by caloric, electricity and chemical action, which it most strikingly characterizes. Yet reflecting on the prodigious intensity in which it has been extricated by the deflagrator, it seems wrong not to suspect it of being an effective constituent of the galvanic stream. Possibly its presence in varying proportions, may be one reason of the incompatibility of the voltaic current as generated under different circumstances, or by various

forms of apparatus. It may also suggest, why in addition to changes in the force or nature of the sensation produced by the galvanic discharges which may be considered as dependent on electric intensity, peculiarities have been observed, which are not to be thus explained. The effect on the animal frame, has been alleged to be proportional to the electrical *intensity*, the effect on metals to the *quantity*; but according to the observations of Singer (which are confirmed by mine) the electrical intensity is as great, with water as with acid, if not greater even than with the latter. The reverse is true of the shock. When the plates of the deflagrator are moistened, and withdrawn from the acid, the shock is far less powerful; yet the electrical excitement appear stronger. Light is undeniably requisite to vegetable life, perhaps it is no less necessary in the more complicated process of animal vitality, and the electric fluid may be the mean of its distribution. The miraculous difference observed in the properties of organic products, formed of the same ponderable elements, may be due to imponderable agents conveyed and fixed in them by galvanism. Hence it may arise, that the prussic acid instantaneously kills when applied to a tongue, containing the same ponderable elements. When by the intense decomposition of matter, light is always evolved; when an atom of tallow gives out enough of it to produce sensation in the retina of millions of living beings why may it not when presented in due form, influence the taste, and otherwise stimulate the nervous system. For such an office its subtilty would seem to qualify it eminently. The phenomena of the fire-fly and the glow worm prove that it may be secreted by the process of vitality.

The discovery of alkaline qualities, as well as acid, in organic products whose elements are otherwise found, whether separate or in combination, without any such qualities, and the opposite habitudes of acids and alkalis with the voltaic poles, and their power of combining with, and neutralizing each other, indicate that there may be something adventitious which causes alkalinity and acidity, and that this something is of an imponderable character, and dependent on galvanism.

In the number of your Journal for October last, I gave my reasons for believing in the existence of material im-

ponderable principles, producing the phenomena of heat light and electricity. The coexistence of these principles in the medium around us, their simultaneous, or alternate agency and appearance, during many of the most important processes of nature, seem to me to sanction a conjecture, that as ingredients in ponderable substances they may cause those surprisingly active and wonderfully diversified properties usually ascribed to apparently inadequate changes, in the proportions of ponderable elements.

In obedience to your request, I have thus displayed the ideas at present awakened in my mind by these obscure and interesting phenomena. I am not willing to assume any responsibility for the correctness of my conjectures. Possibly they may excite in you farther and more correct speculations.

LETTER V.—From the Editor, to Prof. Robert Hare, M. D.

FUSION OF CHARCOAL, by the Deflagrator, with proofs of a current between the Poles.

Yale College, New-Haven, May 10, 1822.

My Dear Sir,

IN your memoir on your Galvanic Deflagrator, (p. 110. Vol. III. of this Journal,) when speaking of the ignition produced by that instrument, in charcoal points, you remark: "If the intensity of the light, did not produce an optical deception, by its distressing influence upon the organs of vision, the charcoal assumed a pasty consistence, as if in a state approaching to fusion.

"That charcoal should be thus softened without being destroyed by the oxygen of the atmosphere, will not appear strange, when the power of galvanism in reversing chemical affinities is remembered; and were it otherwise the air could have no access, first because of the excessive rarefaction, and in the next place as I suspect on account of the volatilization of the Carbon, forming about it a circumambient atmosphere. This last mentioned impression arose from observing, that when the experiment was performed in *vacuo*, there was a lively scintillation, as if the Carbon in an

aeriform state, acted as a supporter of combustion on the metal."

This paragraph, at the time of perusing it, excited in my mind a lively interest, and a strong wish to see so fine a result, as the fusion of charcoal, confirmed by an experiment admitting of no question. What you threw out by way of surmise, and without positively affirming it, I think I am now able to substantiate.

During the three last weeks of March, I was much occupied with your deflagrator. The medium of communication, between the poles, was generally, charcoal prepared for the purpose, by intensely igniting pieces of very dry mahogany, buried in a crucible, beneath white siliceous sand. The pieces of charcoal thus prepared, were about half an inch in diameter, and from one and half inch, to three inches in length; they were made, as usual, to taper to a point, and the cylindrical ends were placed in the sockets, connected with the flexible lead tubes, which form the polar terminations of the series.

The metallic coils of the deflagrator, being immersed, on bringing the charcoal points into contact, and then withdrawing them a little, the most intense ignition took place, and I was surprised to observe, that the charcoal point of the *positive pole*, instantly *shot out*, in the direction of the longer axis, and thus grew rapidly in length; it usually increased, from the 10th to the 8th of an inch, and in some instances attained nearly 1-4th of an inch in length, before it broke off and fell. Yesterday and today, I have carefully repeated these experiments, and in no instance, has this shoot from the positive pole failed to appear. It continues to increase rapidly, as long as the contiguous points of charcoal are held with such care, that they do not strike against each other. When they impinge with a slight shock, then the projecting shoot or knob breaks off and falls, and is instantly succeeded by another. The form of the projecting shoot, is sometimes cylindrical, but more generally it is that of a knob, connected with the main piece of charcoal, by a slender neck, much resembling some stalagmites. It is always a clear addition to the *length* of the charcoal, which does not suffer any waste except on the parts, *laterally* contiguous to the projecting point.

The charcoal of the negative pole, in the mean time, undergoes a change precisely the reverse. Its point instantly disappears, and a crater-shaped cavity appears in its place; it suffers a rapid diminution in the direction of its length, and immediately under the projecting and increasing point of the positive pole; but it is not diminished, or very little, on the parts laterally contiguous. If the point of the positive pole be moved over various parts of the contiguous negative charcoal, it produces a crater-shaped cavity over every place where it rests, for an instant. In every repetition of the experiment, (and the repetitions have been numerous,) this result has invariably occurred. *It appears as if the matter at the point of the negative pole was actually transferred to the positive, and that the accumulation there, is produced by a current flowing from the negative to the positive, or at least by an attraction exerted in that direction, and not in the other.* It does not appear easy to reconcile this fact with any electrical or igneous theory.

In order to ascertain whether the projection of the charcoal at the positive pole was caused by an actual transfer of carbon from the negative, a piece of metal was substituted for the charcoal at the negative pole, and when the two were brought into contact, the charcoal point of the positive pole remained unaltered in form, although a little shortened by the combustion. The experiments with the two charcoal points were varied by transferring, that at the positive end, (and on which a projection was already formed) to the opposite pole, and that at the negative, and in which a corresponding cavity appeared, to the positive.

The result was, that the cavity now placed at the positive pole, disappeared, and was immediately seen at the negative; while the projection, now placed at the negative pole, was transferred to the positive. These experiments were several times repeated, and uniformly with the same result. They seem to leave no doubt, *that there is a current from the negative to the positive pole, and that carbon is actually transferred by it in that direction;** if transferred, it must probably be in the state of vapour, since it passes through

* Those who would contend for a current in the opposite direction, would probably say, that the projecting point of the positive pole, is formed from the carbon, contiguous on the sides, and that the stream of heat burns the cavity in the opposite pole; in either way a current is proved.

the ignited arch of flame, which is formed when the points are withdrawn a little distance ; when it arrives at the positive pole, it there concretes in a fluid, or at least in a soft or "pasty" state.

But the most interesting thing remains yet to be stated. On examining with a magnifier, the projecting point of the positive pole, it exhibited decisive indications of having undergone *a real fusion*.

The projecting point or knob, was completely different from the charcoal beneath. Its form was that of a collection of small spheres aggregated ; exhibiting perfectly, what is called in the descriptive language of Mineralogy, botryoidal or mamillary concretions. Its surface was smooth and glossy, as if covered with a varnish ; the lustre was metallic, the colour inclining to grey, exhibiting sometimes iridescent hues, and it had entirely lost the fibrous structure. In short, in colour, lustre, and form, the fused charcoal bore the most striking resemblance to many of the beautiful stalactitical and botryoidal specimens of the brown hæmatite. The pores of the charcoal had all disappeared, and the matter had become sensibly harder and heavier.

I repeated the experiments, until I collected a considerable quantity of these fused masses ; when they were placed contiguously, upon some dark surface, with some pieces of charcoal near them, they appeared when seen through a magnifier so entirely different from the charcoal, that they would never have been suspected to have had any connexion with it, had it not been, that occasionally some fibres of the charcoal adhered to the melted masses. The melted and unmelted charcoal, differ nearly as much in their appearance as pumice-stone and obsidian, and *quite* as much as common stones do, from volcanic scorix, excepting only, in the article of colour. It is to be understood, that the examination, is in every instance, made by means of a good magnifier, and under the direct light of the sun's rays, as the differences are scarcely perceptible to the naked eye, especially in an obscure light. The portions of melted charcoal, are so decidedly heavier than the unmelted, that when fragments of the two of a similar size are placed contiguously, the latter may be readily blown away by the breath, while the former will remain behind ; and when the vessel, containing the pieces is inclined, the melted pieces will roll with mo-

mentum, from one side to the other in a manner, very similar to metallic substances, while the fragments of charcoal will either not move, or move very tardily.

It should be observed, that during the ignition of the charcoal points, there is a peculiar odour, somewhat resembling electricity, and a white fume rises perpendicularly, forming a well defined line above the charcoal. There was also, a distinct snap or crackling when the two points were first brought together.

Wishing to ascertain whether the Alkali, present in the charcoal, had any effect in promoting the fusion, some pieces of prepared charcoal, were thoroughly boiled in water, and were then again exposed to a strong heat in a furnace beneath sand in a crucible. These pieces when connected in the circuit exhibited the same appearances as the others and proved equally fusible.

Without destroying cabinet specimens, I could procure no diamond slivers, and have not therefore, attempted the fusion of the diamond, which must be left to another opportunity. Our circle of fusible bodies, so much enlarged by the use of your instruments, is now so nearly complete, that it would be very desirable to fill the only remaining niche, namely, that occupied by plumbago anthracite, and the diamond.

I remain as ever, truly your friend and
servant,

B. SILLIMAN.

P. S. I do not suppose, that those who repeat these experiments, will succeed with the common galvanic apparatus. I deem it indispensable, that they be performed with the *deflagrator*, and with one equal in power to mine.

ART. XIII.—*Analysis of the Tabular spar, from the vicinity of Willsborough, lake Champlain, and of the Pyroxene and Colophonite, which accompany it; by HENRY SEYBERT, of Philadelphia.*

1. *Tabular spar.*

This mineral is white. Lustre, pearly and splendid. It appears to be composed of coarse granular portions intimately interwoven; on a close examination, they exhibit the appearance of hexagonal tables, striated on the surface, easily frangible in the direction of the striæ, and have a cleavage in the opposite direction. Fragments highly translucent. Scratches glass, but does not scintillate with steel. Does not phosphoresce when heated.* Specific gravity 2.884. Fusible, before the blowpipe, into a transparent colourless vitreous globule. When boiled, with concentrated nitric acid, it dissolves partially, and yields a solution, which precipitates abundantly with an oxalate; or an excess of sub-carbonate of soda.

Analysis.

A. 3 grammes of Tabular spar, finely pulverized, were exposed to a red heat, in a platinum crucible, the powder remained colourless, after the calcination the weight was 2.97 grammes, therefore the diminution, due to moisture, amounts to 0.03 grammes, on 3 grammes, or 1.0 per 100.

B. The calcined mineral (A) was heated to redness, during 30 minutes, with 9 grammes of caustic potash, in a silver crucible, the mass when cold was treated with water and an excess of muriatic acid, the solution was of a light yellow colour, on evaporation it became gelatinous, the dry mass was treated with water, acidulated with muriatic acid, and again moderately evaporated; it was then treated with water and filtered, the Silica, remaining on the filter, afteredulcoration and calcination, weighed 1.53 grammes on 3 grammes, or 51.0 per 100.

* According to Mr. Haüy, Tableau Comparatif, p. 66, the Tabular spar from Dognazka is phosphorescent in the dark when scratched with steel; Dr. Meade who discovered this mineral in the United States, in 1809, informed me that recent specimens were likewise phosphorescent by friction.

C. After the separation of the Silica from the liquor (B,) the excess of acid was neutralized with ammonia, when treated with the hydro sulphate of ammonia, it produced a black precipitate; this precipitate, washed and dried, was calcined, in order to volatilize the greater part of the sulphur, it was then treated with a little nitric acid and exposed to a strong red heat, it then weighed 0.04 grammes on 3 grammes, or 1.333 per 100. This precipitate on examination proved to be Alumina and Peroxide of Iron.

D. When oxalate of Potash was added to the liquor (C,) a voluminous precipitate was formed, which on exposure to a high temperature, yielded 1.38 grammes of Lime on 3 grammes, or 46.0 per 100.

E. The liquor (D,) after phosphate of soda and ammonia had been added to it, was boiled and was thus found to contain only a slight trace of Magnesia.

This mineral is composed in 100 parts of

A. Water	-	-	01.000	containing oxygen.	
B. Silica	-	-	51.000	-	25.65
C. Alumina and Oxide					
of Iron	-	-	01.333	-	_____
D. Lime	-	-	46.000	-	12.92
E. Magnesia	-	-	a trace	-	_____
			99.333		
			100.000		
			000.667		

This Tabular spar is, therefore, a Bisilicate of Lime, and its mineralogical formula is $Ca S^2$.

This substance, was by some mineralogists in America and in Europe, supposed to be Ichthyophthalmite, whilst others considered it Tremolite. The above results prove, that its composition differs essentially from that of the minerals with which it had been confounded. On comparing the external characters with Karsten's account of the Tafelspath (a mineral until lately, found only at Dognazka in Hungary,) but more especially from its chemical composition, I determined it to belong to that species. "The Tafelspath of Hungary is milk white, and consists of coarse granular hexaedral portions intimately interwoven, alternately channelled on the disjointed surfaces." According to

Klaproth, Hemgariar variety is constituted per 100 of Silica 50.0, Lime 45.0, and Water 5.0.*

The chief difference of my results, from those of Professor Klaproth, concerns the water contained in the specimens respectively examined. M. Berzelius considers the water in this mineral as *accidental*, and observes that some specimens contain no water.† My statements are confirmed by an analysis of the Tabular spar, from Pargas, by M. Bonsdorff, of Albo;‡ his experiments gave the following results per 100, viz.—Silica 52.58, Lime 44.45. Magnesia 0.68, Protoxide of Iron 1.13, Alumina a trace, Volatile matter 0.99.

It is an interesting fact, that this mineral, whether found in Hungary, Sweden, or in the United States, is constantly associated with substances of corresponding characters; that of Dognazka is united with brown crystallized Garnets and blue calcareous spar: that of Pargas, with black sphene, an amorphous mineral, of a reddish colour, resembling Idocrase or Garnet, and small grains of a green substance, resembling Actynolite (probably Pyroxene :) that of the United States with Colophonite and Pyroxene.

2. Green Pyroxene.

Colour emerald green, powder nearly white. Transparent. Lustre, vitreous. Scratches glass. Has a cleavage. Granular, and is found imbedded in Tabular spar, accompanied by Colophonite, the grains are frequently compressed. Not magnetic. Specific gravity 3.377. Fusible, before the blowpipe, into a dark opaque globule.

Analysis.

A. 3 grammes of this mineral, having been selected with great care, were reduced to an impalpable powder, and exposed to a red heat; the color of the powder underwent no alteration, there was therefore no absorption of oxygen; the weight, after the calcination, was 2.98 grammes therefore the moisture amounts to 0.02 grammes on 3 grammes, or 0.666 per 100.

* Beiröge, 3. p. 289.

† Nouveau Systeme Mineralogique, p. 28.

‡ Annals of Philosophy, Oct. 1820. p. 300.

B. The residue of the calcination (A,) was treated with caustic potash, as in the preceding analysis, it was then greenish yellow, and the water, which was used to detach it from the crucible, assumed a light green colour, hence a trace of Manganese. By the usual treatment, with an excess of muriatic acid and the subsequent evaporation of the liquor, &c., the Silica obtained weighed 1.51 grammes on 3 grammes, or 53.333 per 100.

C. After the excess of acid, of the liquor (B) was neutralized with ammonia, it was treated with the hydro-sulphate of ammonia, the black precipitate thus produced, after ignition and calcination with nitric acid, yielded 0.70 grammes of a residue, which, on being repeatedly treated with caustic potash, was found to consist of 0.664 grammes of Peroxide of Iron (but owing to the green colour of the mineral, the Iron must be estimated as a protoxide,) and the 0.664 grammes of peroxide an equivalent to 0.612 grammes of Protoxide on 3 grammes, or 20.40 per 100; and Alumina 0.046 grammes, on 3 grammes, or 1.533 per 100.

D. The lime obtained by the calcination of the calcareous oxalate, which was produced by the addition of oxalate of potash to the liquor, (C) amounted to 0.58 grammes on 3 grammes, or 19.333 per 100.

E. The Magnesia was precipitated in the liquor, (D) by Phosphate of Soda and Ammonia, the ammoniacal Phosphate of Magnesia thus formed, after being calcined, gave 0.56 grammes of phosphate of Magnesia, equivalent to 0.205 grammes of Magnesia on 3 grs. or, 6.833 per 100.

Therefore the constituents of this mineral are,

		per 100 parts,	
A. Water,	- - -	0.666, containing oxygen,	—
B. Silica,	- - -	50.333,	25.31
B. Protoxide of Manganese,	a trace	- - -	—
C. Protoxide of Iron,	- - -	20.400,	04.64
C. Alumina,	- - -	01.533,	—
D. Lime,	- - -	19.333,	05.43
E. Magnesia,	- - -	06.833,	02.64
		99.098	
		100.000	
		000.902	Loss.

On comparing the oxygen of the Silica, with that of the bases, it is evident, that it forms with them Bisilicates, and the mineralogical formula is $MgS^2 + 2CaS^2 + 2FeS^2$.

3. Colophonite,

Occurs frequently disseminated and imbedded with green Pyroxene in Tabular spar, sometimes it forms considerable veins in that mineral. Colour in mass, deep reddish brown, in the state of powder it has a yellowish tinge. Irised on the outer surface. Lustre resinous. Granular, the single grains are highly translucent. Fracture of the mass irregular, the grains have a cleavage. Scratches glass and scintillates with steel. Easily frangible. Not magnetic. Specific gravity, 3.896. Fusible before the blowpipe into an opaque black bead.

Analysis.

A. 3 grammes of the pulverized mineral after exposure to a red heat weighed 2.99 grammes therefore the moisture dissipated by this treatment amounts to 0.01 grammes, on 3 grammes or 0.333 per 100. The protoxide of Iron absorbed no oxygen for the color was not altered.

B. The calcined mineral, (A) when boiled with nitromuriatic acid became gelatinous, yielding a solution of a reddish yellow colour, the whole was evaporated to a dry mass, it was then heated with water, acidulated with muriatic acid, and again moderately evaporated; the residue was treated with water and filtered, the Silica remaining, on the filter after being washed and heated to redness weighed 1.14 grammes on 3 grammes or 38.00 per 100. This product on examination proved to be free from Titanium.

C. The filtered liquor (B) was neutralized with caustic potash, the solution when heated with the hydro sulphate of potash gave a black precipitate which having been heated as in the analysis of the Tabular spar yielded a residue weighing 1.00 grammes, this was repeatedly calcined with 3 times its weight of caustic potash, no camelon having been produced, it was evident that the mineral in question contained no manganese. After the entire separation of the Alumina was effected the Peroxide of Iron weighed 0.82

grammes. A portion of the Colophonite in the state of a fine powder was treated with nitric acid and calcined, and became of a dark red colour, this shewed that the Iron exists in the state of a protoxide and the 0.82 grammes of peroxide are equivalent to 0.756 grammes of Protoxide on 3 grammes or 25.20 per 100.

On estimating the Alumina contained in the Saline liquor by difference we have 0.18 grammes on 3 grammes or 6.0 per 100.

D. When oxalate of potash was added to the preceding liquor (C) a precipitate was formed, which after being washed and strongly calcined gave 0.87 grammes of Lime on 3 grs. or 29.0 per 100.

E. The liquor (D) was boiled with caustic potash, and was thus found to contain no Magnesia.

The result of this analysis is thus, per 100 parts.

The result of this analysis is, per 100 parts					
A. Water,	-	-	00.333	containing oxygen,	
B. Silica,	-	-	38.000	-	19.11
C. Protoxide of Iron,			25.200	-	05.73
C. Alumina,	-	-	06.000	-	02.80
D. Lime,	-	-	29.000	-	08.14
			98.533		
			100.000		
			001.467	Loss.	

Therefore the mineralogical formula of this Garnet is $\text{Al}_2\text{S}^2 + 2\text{FeS} + 3\text{CaS}$.

N. B. The results of my analysis of the Tabular spar, were communicated to the Academy of Natural Sciences the 5th of March, 1822.

ART. XIV.—*Analysis of the calcareous oxide of Tungsten, from Huntington. Con.* By GEORGE T. BOWEN.

THIS mineral was discovered a short time since among some ores brought for examination by Mr. E. Lane. The specimen submitted to analysis was massive. Its colour was yellowish gray—fracture small foliated—lustre resinous

—brittle—is scratched by a knife—infusible before the blowpipe. The specific gravity of a pure piece was 5.98. It occurs in a gangue of quartz, associated with the ferruginous oxide of Tungsten.*

Analysis.

A. Distilled water digested upon the mineral in powder, dissolved nothing. It was then treated with ammonia, but no portion of it was dissolved. Fifty grains exposed for one hour to a high red heat in a platina crucible, lost nothing perceptible of their weight.

B. One hundred grains of the mineral reduced to a fine powder were mixed with three times their weight of pure caustic potash and exposed for one hour to a moderate red heat in a crucible of pure silver. The contents of the crucible when removed from the fire, were of a blue colour resembling smalt. The mass after having been digested with water was thrown on a filter and the insoluble powder repeatedly washed with distilled water. Upon this powder when collected, diluted muriatic acid was poured when it was entirely dissolved, with effervescence excepting .5 grains of silex.

C. The muriatic solution was then evaporated to dryness, and the mass treated with distilled water, when there remained undissolved, one grain of a powder having a dark brown colour. Nitric acid when digested upon it, dissolved it in part and left .25 grain silex. The nitric solution was precipitated by ammonia; the precipitate when washed and dried, weighed .74 grain. It was then treated with muriate of ammonia, to which a small quantity of sugar was added in order to separate the oxide of manganese.† The oxide of iron remaining undissolved amounted to .55 grains; we have then by difference, oxide of manganese equal to .19 grain.

D. The solution of the muriate in water was tested for iron, but none could be discovered. It was then decomposed by carbonate of soda at a boiling heat; the precipi-

* It is also accompanied by native bismuth, native silver, galena, sulphate of lead, and magnetic, and common pyrites.

† This method of separating iron from manganese is recommended by Mr. Faraday. Jour. Royal Institution. VI. 357.

tate which was produced when collected and dried at a low red heat weighed 34.75 grains. It was redissolved in muriatic acid with effervescence, excepting .46 of silex, and again precipitated by sulphuric acid; it was therefore carbonate of lime. Deducting the .46 grain of silex, it amounted to 34.29 grains of carbonate, which equal 19.36 lime.

E. The alkaline solution containing the tungstic acid was evaporated to dryness, when it appeared in the form of small crytalline grains. The mass being treated with water there remained undissolved a brown powder, which when dried, weighed 1.75 grain. Nitric acid dissolved the metallic oxides by which it was coloured, and left 1.13 grains of silex. The nitric solution was precipitated by ammonia, and the precipitate afterwards treated with muriate of ammonia as before, (C) when it was found to consist of oxide of iron .48 grain, and oxide of manganese .12. The results (in C and E) give a total of oxide of iron amounting to 1.03 grains and of oxide of manganese equal to .31 grain.

F. The solution (E) was then decomposed by muriatic acid, and the precipitate which was produced collected and dried at a red heat; it assumed a yellow colour; and weighed 76.25 grains. Liquid ammonia when digested upon it dissolved it almost entirely, leaving .20 grain of silex. The ammoniacal solution when evaporated yielded white needle form crystals, which became of a yellow colour when calcined. They were completely redissolved in ammonia, and again precipitated by acids. This powder was therefore the tungstic acid. Deducting the 20 grains of silex, it amounted to 76.05 grains. The results (in B. C. D. E. and F.) give a total of silex amounting to 2.54 grains.

One hundred grains of the calcareous oxide of Tungsten consist, according to this analysis of

Tungstic acid,	-	-	-	-	76.05
Lime,	-	-	-	-	19.36
Silex,	-	-	-	-	2.54
Oxide of Iron,	-	-	-	-	1.03
Oxide of Manganese,	-	-	-	-	0.31
					99.29
					100.00
					000.79 Loss.

* * * * *

The calcareous oxide of Tungsten of which the above is an analysis exists pure and is uncontaminated by any foreign substances. There however occurs in the same mines a tungstate of lime, mechanically mixed with the native massive oxide of Tungsten, mentioned in the American Journal of Science, Vol. IV. p. 187. The native oxide, in minute veins, is disseminated through the tungstate of lime, and is easily distinguished by its bright orange colour, from the calcareous oxide, which colour is yellowish gray. When the powder of this mineral is treated with warm ammonia, the native oxide is dissolved, while the tungstate of lime remains unaffected.

The yellow oxide of tungsten occurs also disseminated in a pulverulent form in cavities and fissures in the ferruginous tungsten of Mr. Lane's mine. See Vol. IV. p. 52 and 187 of this Journal.

ART. XV.—*Wet or damp clothes, good conductors of lightning. Illustrated in the case of John Williams Esq. of Conway, Massachusetts.*

[Communicated for this Journal by the Rev. Edward Hitchcock.]

IF the following statement communicated to me by J. Williams Esq. be thought subservient to the cause of humanity or science, it is offered for insertion in the American Journal of Science.

Sept. 2nd, 1816, about sun-set a violent thunder storm arose from the north-west; and for more than three hours, the heavens were in an almost constant blaze. Mr. Williams was standing in the front door of his house, in Conway, with his face directed southerly; when he was thrown senseless on the floor by a stroke of the lightning. It seems the fluid first entered the roof of his house a few feet above his head, passed down the right hand side of the door, tearing off the ceiling—entered his right shoulder, went along his right arm to the hand—then struck his right hip, and running spirally down the back part of his thigh till it reached the knee, the main part of the charge passed into the left leg and went out through the sole of the shoe while

the residue of the charge, followed down the right leg. The charge entered the wall of the cellar and made a rent therein. Marks of the lightning were also visible at the north-west angle of the house; where, the ceiling of the kitchen was torn off, a plank split in a well room, and two furrows ploughed in the earth; one of which, passed under a Lombardy poplar tree, standing in the door yard. The right sleeve of Mr. W's shirt and coat, both legs of his pantaloons, and the stocking on his left leg, were torn almost entirely open, and so mutilated several inches in width, as to hang in shreds and threads, appearing as if drawn across a hatchel. His coat was *seersucker*, (cotton and silk,) and the lining, striped linen—his shirt was linen—the pantaloons Nankeenet or (linen and cotton,) and the stockings, cotton. One of the quarters of the left shoe was torn off—the sole much mutilated, and a hole perforated in it, as if a large nail had been driven through it.

Another circumstance important to be noticed, is, that his clothes were a little wet; he having been exposed to the storm in its commencement.

Mr. W. remained senseless a few minutes, and says that the sensation he experienced while resuscitating, is faintly described by comparing it with that of Gautimozin when stretched upon the burning coals. Indeed the first impression on his mind, which he recollects, was, that he was actually immersed in the "furnace of fire," described in the sacred scriptures. His right arm was scorched its whole length—a spot several inches in diameter on his right hip—spaces on both legs below the knees and on the left foot, and his feet were benumbed for several days. His senses soon returned, and after the fiery anguish above named, little pain was felt, and in a fortnight, or three weeks, he was restored to usual health.

A candle burning at the time of the stroke near the centre of the west room in Mr. W's house was extinguished; and it was found difficult to relight it. The usual sulphurous smell was noticed.

On the south and west sides of Mr. W's house, were several Lombardy poplar trees sixty or seventy feet high, rising thirty or forty feet above his house, which was one story and an half. One of these trees is not more than six feet from the spot where the lightning first struck, and yet, nei-

ther this tree nor any of the others were affected. It ought however to be mentioned that there is an iron bolt, six inches long, in the top of the post near the door of the house, and perhaps this attracted the fluid.

Query. Are not Lombardy poplars worse conductors of lightning than other timber, and therefore less valuable near dwellings?

Mr. W.'s house stands nearly at the foot on the west side of a steep rocky hill of mica slate, two or three hundred feet high. I would make the enquiry, whether, in this part of our country, (as most of our thunder storms pass from west to east,) the western side of mountains is not more frequently struck with lightning than the eastern? For, before the clouds reach the eastern side of hills, are they not usually in a good measure discharged?

A person examining Mr. Williams' clothes, which were mutilated in the manner described above, and which are still carefully preserved, would not suppose it possible for him to have escaped with his life. I feel satisfied that he owes his life to the circumstance that his garments were slightly wet. To support this opinion, I make the following extracts from Dr. Franklin's letters to P. Collinson Esq. Third London edition, pa. 36 and 47.

"Electrical fire loves water, is strongly attracted by it, and they can subsist together."

"It is safer to be in the open field (during a thunder storm) for another reason. When the clothes are wet, if a flash in its way to the ground should strike your head, it will run in the water over the surface of your body; whereas if your clothes were dry, it would go through the body."

"Hence a wet rat cannot be killed by the exploding electrical bottle, when a dry rat may."

These facts, at first view, appear conclusive on this point. I am aware however, that Mr. W.'s clothes were all non-conductors, and "that the fluids of the human body are better conductors of electricity than water." (Rees Cyclopedia. Art. Electrical.) It does not appear, however, from the experiment of Rees referred to, that animal fluids, *while they remain in the system*, are better conductors than water. But I will not enlarge—If the opinion I have advanced be not tenable, let it be abandoned: for the truth on this subject may be of some consequence. Remarks by the Editor of the Journal would be very acceptable.

REMARK.

The Editor entirely coincides with the Rev. Mr. Hitchcock, in opinion as to the cause of the preservation of Mr. Williams' life. It occurs to him however that as Mr. Williams' clothes were but slightly wet, his skin was probably dry. Although therefore the animal fluids may be better conductors than water, yet the dry cuticle or skin, is not a good conductor, and therefore the electrical current preferred to take its course through the moisture in the clothes rather than to force its way through the skin to the animal fluids.

We subjoin Mr. Williams' own minute of the facts, for although substantially embraced in Mr. Hitchcock's account—the relation of the sufferer himself has in it interesting traits of verisimilitude.

Description of the Plate annexed.

No. 1. Mr. W.'s Pantaloon as torn by the lightning.

— 2. ——— Stocking.

— 3. ——— Shoe exhibiting the perforation in the sole.

— 4. ——— Quarter of the shoe, torn off.

— 5. ——— Coat sleeve.

— 6. ——— Shirt sleeve.

1X A weeping willow.

X Tall Lombardy poplars.

 Doors that were so far open.

B. 3. 3. Furrows ploughed in the ground by the lightning.

2. The position of J. W. when struck down—he was looking to the south east—the first of the fluid on the house was at the bottom course of shingle splitting four inches—then started off the eave trough 20 feet in length—then stripping off the post and door casings and some of the outside covering—took my right shoulder below the joint, burning and scorching to the end of the sleeve, then the right hip burning seven inches square, then down the inside of the lower limbs with a streak of the burning to the knees, burning, on the inside of the right leg, the bigness of a hand, and left the leg, leaving two holes through the stocking—from the left knee to three inches below, no burn—then burning down to the heel and under it, and blistering the lap of the left foot half the surface of it and stripping the clothes in a manner not easily described—I was thrown prostrate, my head to the east, my face to the north, senseless—the length of time, I am not able to ascertain, nor to describe the sensation on coming to, my legs were so benumbed as to be useless, and so remained till the lancet was used, which gave some relief. The physician wet cloths in the oil of terabinth through the night and kept them on for four days, when the fire was principally extracted—I was compelled to lie nine days on the left side—the 12th sat up half a day at times, and the 14th began to walk.

 Table on which a large candle was burning, which was put out by the fluid, and which afterwards it was difficult to light. Mrs. Williams standing at the east end of the table at the time of the shock. It was

powerful on the left ear for three or four hours. It caused in the head a ringing like the ringing of tumblers. The residue of the family, three children, were in bed in the chambers, and not otherwise affected than by a start by the report.

A neighbour six rods distant standing at his door was stunned and falling, but was caught by his family.

Another family in a small building two rods distant only affected by the report—at the north-West corner of the room, a large heavy table and chair moved two feet from the wall, the whole ceiling started. The fluid passed down after leaving my body, between the sill and a stone step through the wall and four feet downwards throwing off much pointing. The dotted line the south side shews the course of the fluid on the cellar wall—the residue its course on the sill, floor or plank on the north side, west on the ground injuring the house and furniture more or less. I had been out in a little dash of rain ten minutes before the shock—the clothes were moist.

Several strokes of lightning apparently from the same explosion.

Extract of a letter to the Editor from Gen. EPHRAIM HOYT,
dated,

Deerfield, Mass. July, 21, 1821.

One question in Electricity and I have done. Have you any certain proofs that lightning strikes at several places (say from twenty to forty rods distance) at the same instant. In a late thunder shower a tree in my garden three rods from my house, a post in a fence twenty rods distant and a walnut tree in the meadow forty rods distant were struck as we suppose at the same instant. The shock was tremendous, and I believe the tree in my garden saved my house and probably our lives. I am of opinion that the lightning ascended. I am sometimes puzzled to account for Electrical Phenomena on known laws and am not certain of the efficacy of rods though I believe them useful in many cases.

ART. XVI.—*Relation of a case of suspended animation by drowning; by LOCKWOOD W. SMITH.*

Read at the annual examination in the Medical Institution of Yale College,
March, 1822.

I have selected this as a subject for the present dissertation. First, because it came under my own observation.—

Secondly, because one remedy was made use of which I have not found in authors upon this subject.—And thirdly, because I think electricity which is disapproved of by most authors, and more from theory than experience was used in this case with obvious advantage. The remedy to which I refer as the one not mentioned by authors, is Tincture of Cantharides in form of injection. This however having been applied at the same time with remedies that are recommended by writers in general, renders it utterly impossible to determine whether it had any effect in the case or not. Yet this certainly is the fact that it was followed by no ill consequence, but on the contrary with the recovery of the patient; the sole thing aimed at in the administration of any medicine.

The principle of life appears, in cases of drowning, not to be entirely extinguished, but to be merely suspended *for a certain length of time*. And it is capable, if proper means be employed *within that length of time*, of being again excited to action. How long after drowning, this principle remains in a state of mere suspension we knew not, nor indeed in any case of suspended animation, are we absolutely sure of death, until symptoms of putrefaction make their appearance. This then implies that in every case where these symptoms are not present, we should immediately, upon the body being found, make every possible effort to restore it to life.

The method which I am about to describe was practiced by the late Dr. Strong, of Petersburg (Va.) and although I was at the time, unacquainted with medicine, still I think I shall be able to state the treatment with a sufficient degree of accuracy.

I will omit the particular circumstances of the accident and merely mention that six persons, of which number I was one, were overset from a boat in Appomatox River. Five, with difficulty, reached the shore, while the other having been caught under the boat, remained in the water. We soon procured another boat, but such were the circumstances, that it was nearly, if not full half an hour before we were enabled to reach the shore with the body. One was immediately sent to inform the friends of the accident, while the remaining four were employed in conveying the body to the nearest house. Happily for the young man

the person sent to inform the friends, met on his way the Physician before mentioned, and to him he of course communicated the accident. Dr. Strong being near his home, immediately took his Electrical machine and proceeded to the house where he found us just arrived with the body. I do not recollect the appearance of the body any farther than that the face was of a dark colour, and as far as we could perceive, life completely extinguished. Dr. Strong adopted the following active means—He first ordered the body to be stripped of the wet clothes and at the same time a bed to be prepared with woollen blankets thoroughly warmed with a common bed pan, and in addition to these he directed a kettle of warm water. As soon as the clothes were off, he wiped the body with a flannel cloth, and laid it between the warm blankets. He then observed that appearances were very much against him, and he was doubtful whether he should succeed. Fortunately however, he did not despair, but still persevered in the application of his remedies. While he was preparing the electricity he directed the body to be rubbed with flannel cloths. He then passed the electric sparks twice in succession through the shoulders and at the same time friction was continued over the whole body, but more particularly about the thorax. The lungs were next inflated by means of the common bellows. All this Dr. Strong observed had no effect. The water by this time was sufficiently warm for his purpose, and of which he took about a pint; to this he added a small quantity of Brandy, with about half a table spoon full of Tinct. Cantharides, and gave it per an. The temperature of the water I do not know. The body in an erect posture, was next conveyed towards the fire, while the bed was again prepared with warm blankets, and the body returned. The electricity was a second time applied, and was immediately followed by a convulsive sigh. I was at this time rubbing the breast with a flannel cloth and could perceive a convulsive effort within the thorax which I supposed to be the first returning throb of the heart, and which was repeated three or four times. The lungs were again inflated, and this also was immediately followed by a convulsive effort to breathe, and by an evident palpitation of the heart. The surface of the body was quite warm at this time, and the friction was consequently discontinued. Air

was a third time blown into the lungs and was followed by a discharge of water from the mouth and nostrils. Aqua ammoniæ was applied to the nose, and volatile linament to the breast and back. The person soon began to breathe with tolerable freedom, and was able to swallow some warm cordial; a small quantity of blood was now taken, and he was the next day conveyed home to his friends.

New-Haven, March 25th, 1822.

ART. XVII.—*On the Natural History of the Ocean, with two sea journals.*

TO PROFESSOR SILLIMAN.

NEW-YORK, April, 2, 1822.

My Dear Sir,

A SHORT time ago, my friend, C. A. Davis, Esq. handed to me a journal kept on board the U. S. Ship Columbus, Com. Bainbridge. Upon comparing it with one that I kept on my passage from Liverpool to New-York, I was induced to turn my attention to the waters of the Ocean—and have drawn up a paper on its Natural History, which I now offer to you. I have of course been obliged to consult several works and papers, from which I have selected such information as accorded with my design.

I place both journals at your disposal.

With much respect,

I have the honor to be

Very truly, yours,

JER. VAN RENSSELAER.

Colour.—Deep indigo blue—green on soundings;—these tints being most distinctly marked in the tropics. In the polar regions, the waters are greenish. Near the Cape of Good Hope, the sea has a reddish tinge, in the month of March, from marine animals: the same appearance is produced by the same cause at the mouth of the river Plate. Admiral Byron observed this on his passage to Rio Janeiro. The bay of California is red, in parts, from the abun-

dance of red fish. Near Sumatra and on the coast of Chili, the water seems red from a minute vegetable substance that floats in it.

Temperature.—At the Equator, the surface water is 80° ; Farenh.; at 28 N. Lat. it is 68° ; at 47 N. Lat. it is 58° ; in the arctic regions it is about 30° ; diminishing as the latitude increases.

The temperature, at a considerable depth, is higher on approaching a coast; but at a distance from land it diminishes as the depth increases. When the atmosphere is 50° ; and the surface water 40° ; it will be perhaps only 25° at the depth of 50 fathoms. The reverse of this was supposed to be true in lakes, but the late experiments of M. de la Beche, prove the Swiss Lakes to agree in this particular with the variations of ocean temperature.

The diminution of temperature on the banks of Newfoundland is so great, that the thermometer may justly be considered as an indicator of the approach to land on the east coast of the U. States.

The Gulf Stream is about 15° warmer than the surrounding bed of the ocean. Summary—

1. The temperature of the ocean diminishes from the Equator to the Polar regions.
2. It decreases near Islands and Continents.
3. It diminishes in wide seas, according to the depth from which it is drawn: except in the polar seas, where the reverse obtains.
4. It is less on sand banks.

Remarks.—It is owing to the extreme mildness and equability of temperature enjoyed by the ocean and supernatant atmosphere, that the good effects are derived from sea air in pulmonary complaints: and not from the saline humidity of the air, as has been asserted. This circumstance has not been sufficiently insisted upon by medical men. We may learn from it the utility of sending patients on a voyage into the wide ocean, where the air is not affected by the various changes on land; we may also see the inutility of coasting voyages for consumptive persons.

Specific Gravity.—The experiments of the celebrated Capt. Scoresby, Dr. Marcet, and Dr. Traill sanction the following inferences.

1. The sp. gr. of the waters of the Atlantic decreases from the Equator to the poles: being at the Equator 1.0295;

and in N. Lat. 66° —1.0259, according to Scoresby: but 1.020, according to Capt. Ross.

2. The sp. gr. increases with the depth from which it is drawn.

3. The Mediterranean sea has a greater sp. gr. than the Atlantic.

4. The water of the Baltic has a less sp. gr. than the Atlantic, being 1.014.

Capt. Scoresby found that the uniformity in the increasing density of ocean waters, was interrupted by the influence of ice.

The 2nd inference is from many experiments on sea water drawn from different depths, and which were found uniform, except when interrupted by partial currents or the influence of ice. The density increasing with the depth of the ocean, Dr. Brewster attributes to the "imperfect elasticity of water, preventing its particles, when compressed by the superincumbent column, from regaining their original condition, when the pressure is removed."

Remarks.—In making experiments upon the density of sea water, Scoresby's Marine Diver is the only instrument calculated to procure it with certainty, from any given depth. For the mechanical compression of water, the Bathometer of our countryman Perkins should be used. "In this machine, water, inclosed in a brass tube, the sides of which need not exceed one tenth of an inch in thickness, is compressed by a solid piston, sliding in a leathern collar, and acted on by the superincumbent column when sunk in the depths of the ocean." (Brand's Journal, and this Journal V. III. p. 347.

Depth.—It is supposed by Hydrographers, and with apparent probability, that the inequalities of the bottom of the ocean are equal to those on the surface of the land. From 1774 to 1785, Cook was endeavouring to find soundings in the Pacific with 250 fathoms of line. Scoresby has used 1200 fathoms in the arctic seas, without finding bottom.

Near to land the depth varies according to the elevation of the coast—if this be steep, the water is usually deep, and the anchorage bad.

Remark.—The sounding line generally used, is inaccurate. The best machine for this purpose, is one invented by Massy, now constantly used in the English Navy, with

which they may sound 30 fathoms, while the vessel is going three miles per hour.

Saltiness of the Sea.—Varies in different latitudes and localities. In the Tropical and Polar regions, the saltiness is the same, diminishing gradually on either side to the temperate. In bays, arms, and at the mouths of rivers, the water contains less salt.

It is doubtful if the saltiness does not vary with the depth.

The salt is deposited when sea water freezes.

The Mediterranean is saltier than the Atlantic; the Baltic less salt.

Generally speaking, the saline matter of the Atlantic is from three to four per cent. say in 1000 grains of sea water are the following, viz. :—

Muriate of Soda,	30.80
Magnesian Salts,	04.00
Sulphate of Lime,	00.80

35.60 or 3.56 per cent.

Sea Ice.—Sea water freezes at 28°. Buffon doubted if it ever froze. Sea ice varies in colour from white and grey, to greenish and sappharine. Its forms are various presenting every shape which fancy can create. Scoresby notices sixteen kinds, known among sailors. Sea ice when melted affords fresh water. Mountains of ice have been seen on the banks of Newfoundland, above 2,000 miles from the place of its formation. They are heavier than the water, and only one eighth appears above the surface. Their approach is known by the effect they produce on the atmosphere—and by the ice-blink, a luminous appearance in the air above them. It is supposed that the poles are surrounded by ice, which prevents access to them. The nearest approach to the North Pole has been the latitude of 82°, or within 510 miles. The nearest approach to the South Pole, has been latitude 72, by Cook, or within 1130 miles. It is a matter of conjecture if either pole will ever be visited.

Motions of the Sea, are of three kinds, viz :—

I. Motion of Waves. II. Motion of Currents. III. Motion of Tides.

1. The motion of waves is preserved by the law of gravitation; the sinking of one wave raising others. It is not known how deep the sea is agitated : divers say to a great

depth; but it is estimated to extend only fifteen fathoms below the surface. According to Boyle's experiments, the wind never affects the water lower than six feet; so that in a calm, the waves of the ocean never exceed twelve feet.

In equatorial regions, the waters must be more agitated than in the polar regions, from the centrifugal force. When the water is very deep, waves have no progressive motion, but remain in situ; but if the bottom is rocky, and not very deep, the waves are interrupted, sent back, and form *breakers*.

Oil spread on the surface of the sea, smooths the water, in some measure, as was noticed by Dr. Franklin; and among the ancients by Aristotle, Pliny, and Plutarch, who mentions that the divers took oil in their mouths, and let it out when under the water, to smooth the surface above them. In the Bermudas, oil is now used to render the water clear for fishing.

Dr. Forster at sea in 1797 saw that the grease thrown overboard by the Cook affected the water to a great distance; and throwing overboard a quantity of oil, he found that it calmed all that portion of the waters. He adds, a teaspoonful spread over several yards: and explains the effect by saying, that the wind could not get a purchase to raise the first ripples, which by increasing, become waves.

II. Motion of Currents.

1. *Equinoctial currents.* Between the Tropics there is a constant motion of the sea from east to west, at the rate of nine or ten miles in the twenty-four hours, which seems caused by the trade winds. Commencing on the West coast of America, and running with great violence to the east coast of Africa, thence on Asia, and again back to the east coast of America. Its course is determined by the land it meets with, and, accommodating itself to the coast, seems to have assisted in forming the Bay of Bengal: whence it runs to the Coromandel coast between Ceylon and Asia.

2. *Polar currents,* running to the Equator, are mentioned by Humboldt, and Scoresby, with a velocity of from one to three miles an hour. Their temperature is lower than the surrounding ocean.

3. *Upper and under currents; or counter currents,* appear in gulphs, bays and enclosed seas. The Atlantic flows into the Mediterranean superficially, while the surplus wa-

ters are carried out below. Between the sea of Marmora and the Euxine these currents exist. Similar motions have been observed at the entrance of the Persian gulf: though the existence of counter currents is not well established.

4. The Gulf Stream. It is characterised by its higher temperature,—its blue deeper than the ocean—its waters more salt—with an atmosphere finer and lighter. It performs a circuit of 3,800 leagues in two years and ten months. The anecdote of the tree from Honduras, mentioned by Humboldt is well known. American trees are yearly deposited on the coast of Ireland. Wind increases the velocity of the stream. It is recorded that the *Filbury*, English man of war, was burnt near Jamaica, and that the masts were found near Scotland. The bowsprit of the *Little Belt* was conveyed nineteen months in a northern direction to the mouth of the B— roads.

Wallace says that in 1682, Esquimaux in leathern canoes came to the Orkney Islands.

III. Motion of the tides. The tides are periodical oscillations of the sea, caused by the sun and moon; but more particularly by the latter. The waters rise highest when the sun and moon are in conjunction and in opposition: the two surfaces being then raised, and producing a more spheroidal form even in the equatorial diameter. (Enf. prop. CLXXIV.) The moon's attraction is nearly three times greater than that of the sun.

Between the tropics the tides set eastward; in the northern frozen ocean they are weak; of the antarctic nothing is known.

The highest tides are on the coast of France, where they are driven from the English coast, and rise seven or eight fathoms.

Luminousness of the Sea, is more evident at particular times and places. Vespuceius was the first modern who noticed it. Bacon observed it, and Boyle collected theories to account for it. In 1703 it first attracted attention, and there is a letter, dated that year from Genoa to Paris, stating that the sea had been luminous fourteen nights, which the learned societies in Paris did not believe.

Four causes have been assigned for it.

- | | |
|--------------------------|--|
| 1. Absorbed solar light. | 3. Electricity. |
| 2. Marine animals. | 4. Decayed animal, and vegetable matter. |

1. Absorbed solar light. Wilson of Edinburgh made many experiments to ascertain if this was true. He found that water retained this property when it had been covered with oil, or when drawn from a great depth. Surface water exposed to the sun's rays retained it. The electrometer did not affect it.

Many substances on land absorb light, and travellers in warm climates are often benefitted by the emission of it.

Gregg mentions a man who could read in the dark—and another who could do the same after drinking wine.

2. Marine animals. Dr. Forster, Oct. 29, 1772, off the Cape of Good Hope, near the shore in a storm, observed every wave to present a luminous crest; and that there was a phosphoric line on the sides of the ship where the waves broke. He also saw large luminous bodies moving in the water, and found that they were fishes; and that when near each other, the small ones swam from the larger. On examining a bucket of water, the luminous particles subsided; but the same property was manifested on agitation. These particles were animals, globular, gelatinous, brownish, and transparent. On the coast of Malabar they are very brilliant. There are several species of animals engaged in this phenomenon: but chiefly two—the *Medusa* and *Physalia*. The former are microscopic, and abundant in warm climates—the latter occasionally exhibit a remarkable phosphorescence. Sir Jos. Banks mentions a species which emitted light equal in quantity to the glow worm.

3. Electric luminousness is seen in the air, like stars and globules: sometimes in the clouds, and part of the ocean. In the Indian Ocean it is a part of the weather.

4. Decayed animal matter becomes phosphorescent, and emits the most brilliant light. Many possess this property.

* Since finishing this paper, I have seen a notice of a paper published by Dr. MacCulloch, in the 10th Vol. of the *Trans. of the Wernerian Society*, in which he mentions that he has yet reached this country, and is now seeing them.

Water Spouts.—At one period they were supposed to be Volcanic. Berthollet and Franklin thought them electric: the clouds and water mutually attracting each other, and they thought their idea was confirmed by the accompanying lightning. Oliver supposed them occasioned by the suction of a cloud. Perhaps the nearest approach to truth is the supposition of the Hon. Capt. Napier. He supposes that many opposite currents of wind, all pointing to a certain centre; and coming in contact with each other, with unequal forces, cause a rotary motion or current of themselves round a central space, which, not partaking of an equal, or its former pressure, naturally becomes rarified by the existing heat, to such an extent, that it speedily acquires a state in a great degree approximating to that of a vacuum.

This continued rotary motion of the air forms a kind of whirlwind: and the pressure of the external atmosphere at the base, forcing the water to a reasonable height up the rarified space within, it is then carried upwards by the mechanical action of the wind, in light and unconnected streaks. The space at the bottom now becoming void, is regularly replenished by the pressure from without, till the whole spout is perfectly completed.

The water having now arrived at the region of the clouds, it is naturally attracted, diffused and connected with and among them; increasing in density and extent, till the lower atmosphere becoming now lighter than the clouds above, these enormous masses, gradually settling downwards, distend, burst, and are dissipated in rain.

A notice of the inhabitants of the ocean belongs more particularly to the zoologist. I shall give only two extracts tending to show the immense number of minute animals in the Greenland seas. They will at the same time exhibit the close investigation and research of that accurate observer, Capt. Scoresby.

On examining some olive green water, he found the number of medusæ to be immense. They were about one-fourth of an inch asunder. In this proportion, a cubic inch of water must contain sixty-four: a cubic foot 110,592; a cubic fathom 23,887,872; and a cubical mile 23,888,000,000,000,000. It may give a better conception of the amount of medusæ in this extent, if we calculate the length of time that would be requisite, with a certain number of persons.

for counting this number. Allowing that one person could count a million in seven days, which is barely possible, it would have required that 80,000 persons should have started at the creation of the world, to complete the enumeration at the present time, (1820.) (Account of the arctic regions. Vol. II. p. 179.

In examining the colouring matter of a yellowish green water, he found it to be animalcules—"Some advancing at the rate of $\frac{1}{100}$ th of an inch in a second, others spinning round with great celerity. But the progressive motion of the most active, however distinct and rapid, it appeared under a high magnifying power, did not in reality exceed an inch in three minutes. At this rate it would require one hundred and fifty-one days to travel a nautical mile. A condor, it is generally believed, could fly round the globe at the equator, in a week; these animalcules, in still water, would not accomplish the same in less than 8955 years.

The vastness of their numbers, and their exceeding minuteness are circumstances of uncommon interest. In a drop of water, examined by a power of 28,224 (magnified superficies) there were fifty in number, on an average, in each square of the micrometer glass, of $\frac{1}{100}$ th of an inch in diameter: and as a drop occupied a circle on a pane of glass containing 529 of these squares, there must have been in this single drop of water, about 26,450 of these animalcules. Hence reckoning sixty drops to a dram, there would be in a gallon of water, a number exceeding by one half, the amount of the population of the whole globe. The diameter of the largest of these animalcules, was only $\frac{1}{100}$ th of an inch—and many only $\frac{1}{100}$ th of an inch. The army which Buonaparte led into Russia, in 1812, estimated at 500,000 men, would have extended, in a double row, or two men abreast, with two feet three inches for each pair of men, a distance of $106\frac{1}{2}$ English miles. The same number of these animalcules, arranged in a similar way, but touching each other, would only reach 5 feet $2\frac{1}{2}$ inches!

A whale requires a sea, an ocean to sport in: about 150,000,000 of these animalcules would have abundant room in a tumbler of water.

Extract from a Journal kept on board the Ship Hector, Capt. Gillander, on a passage from Liverpool to New-York, in Dec. 1819, and Jan. 1820. By J. V. R.

Date.	Lat. No.	Long. W.	Temp. of air.	Temp. of water.	
Dec. 1	52°—	8°20'	52	52	This had been the state of the air and water for several days;—we left Liverpool, Nov. 26th, but as there had been no variation in the Thermometer; its state is now first noted.
2	51°36'	9°	52	51½	
3	50°50'	9°30'	52	51	
4	49°56'	10°	52	52	
5	48°32'	11°	53	56	
6	47°16'	15°42'	53	57	
7	46°30'	20°	54	57	
8	46°51'		56	58	
9			57	58	No observation.
10	46°35'	25°	61	59	
11	46°8'	28°30'	58	62	
12	45°16'	31°30'	58	61	
13	44°40'	35°20'	60	63	No observation.
14			62	63	
15	43°15'	43°33'	62	63	
16	43°1'		63	66	
			55	64	At 8 A. M.
			53	52½	At 10 A. M.
			52	50	At noon.
			50	46	At 4 P. M.
17	42°30'		50	46	At 8 P. M.
18	41°51'	54°	48°	45½	At 4 P. M.
			56	63	
19	41°41'	58°	45	56	
20	41°40'	62°	47	49	
21		63°30'	46	58	
22			50	68	
23	41°5'		53	68	
24			62	70	
25			61	71	No observation.
25			54	57	Do. Do.
			36½	54	Do. Do.
26	40°4'	67°	38	58	
			44	50	
27	41°	67°	44	46	
28	40°5'		37	43	
			38	45	At 4 P. M.
29	39°18'		39	58	
			40	59	At 4 P. M.
30	40°15'		42	28½	
31			41	30	No observation.
Jan. 1			40	27½	Do. Do.
2	40°26'		31°	40	
3	39°40'		29	39	
4			30	40	
5	40°1'		32	39	
6			29	40	Do. Do.
7			32	47	
					Entered the Bay of New-York.

Notes and observations made on board U. S. Ship Columbus, Commodore Bainbridge, on her passage from Gibraltar to Boston, June and July, 1821—by C. A. DAVIS.

June and July 1821		Lat.	Lon. W.	Barom.	Ther. in air	Ther. in water	Winds, and state of the weather, &c. &c.
June	July						
♂	June 6	35-58	5-44	30-7	71		E. N. E. fresh breeze, clear sky, left Bay of Gibraltar about 11 A. M.
24	7	36-13	7-56	30-8	73		N. N. W. light breeze, clear sky, smooth sea.
♀	8	35-48	10-02	30-12	66		N. strong, with thin clouds.
♂	9	36-5	13-22	30-12	66		N. N. E. free breeze with some clouds.
♂	10	36-13	16-54	30-15	68		N. N. E. light with thin clouds.
♂	11	36-8	19-16	30-16	69		E. light, sky partly clouded.
♂	12	36-14	20-43	30-8	69		S. E. a free breeze, sky cloudy, with some rain.
♂	13	36-16	23-7	29-7	67		S. W. by W. light, with occasional squalls, cloudy with much rain—current S. E. by E. $\frac{1}{2}$ E. $\frac{1}{2}$ mile 15 hour.
24	14	36-	25-54	30-18	66		N. N. E. fresh, flying clouds, variation of Compass 23° 55' West.
♀	15	35-48	27-19	30-19	68		S. W. light, cloudy, very hazy.
♂	16	36-27	30-7	30-1	69		E. N. E. light, cloudy and hazy.
♂	17	36-19	32-44	30-14	69		E. S. E. a fine breeze, foggy and rain.
♂	18	35-44	32-46	30-1	71		W. foggy and drizzly rain, wind light and variable.
♂	19	35-34	33-23	29-92	71		Calm, broken clouds and hazy, quantity of Gulf-wind passing—outer edge of Gulf-stream.
♂	20	35-11	35-55	30-5	69		N. by E. fine breeze, judged ourselves in the influence of the Gulf-Stream.
24	21	35-9	38-42	30-13	70		N. light, at 10 A. M. ion. by Sun, 39° 10' 22"; 10' 20" E. of Chron'r.
♀	22	34-57	39-37	30-19	69		N. light, some clouds and hazy; morning Ther. 71° in air and water.

Continued.

Winds, and state of the Weather, &c. &c.

June and July 1821							Winds, and state of the Weather, &c. &c.	
	Lat.	Lon. W.	Barom.	Ther. in air.	Ther. in water			
June 23	34.39	40.28	30.19	71	72	S. W. by S. light, broken clouds, and clearing, quantity of Gulf-weed around us.		
24	35. 3	42.51	29. 7	71	71	N. by W. fresh, cloudy and rain, increasing, and hawing to S. W.		
25	36.13	42.38	29. 7	71	70	W. by N. blowing fresh, with a heavy sea, ship labouring very much.		
26	35.42	42.33	29.75	70	68	W. N. W. fresh, cloudy, humid and frequent showers.		
27	34.40	42.53	29. 8	71	72	W. N. W. fresh, squally, humid and cloudy, towards eve. inclining to moderate.		
28	34.48	42.51	29.96	68½	71½	N. W. by W. light cloudy, sea falling.		
29	33.26	44.24	30.15	72	71½	W. N. W. light and variable, quantity of Gulf weed passing.		
30	34.20	45.14	30.16	74	72	S. W. by W. light, thin flying clouds inclining to humidity.		
July 1	35.20	47. 4	29.95	73	70½	S. W. fresh breeze, rough sea, rainy and squally.		
2	35.45	47.58	30.17	70	70½	N. W. by W. light, and occasionally clear and agreeable.		
3	35. 8	48.36	30. 3	73	74	W. almost calm lon. ☉ 48° 35' 45" ch'r 48° 47' 52".		
4	35.40	49.33	30.29	74	72	S. W. by W. light breezes, inclining to hazy; our Columbia's birth day, fully attended to.		
5	36.32	50.13	30.23	75	72	W. S. W. fresh and very humid, flying clouds, hazy with rain.		
6	36.23	51.34	30. 1	75	73	W. S. W. fresh and squally, cloudy and damp; supposed to be in counter current of Gulf-Stream.		
7	36. 5	52.11	29.85	74	73	S. W. by W. fresh and squally, cloudy and damp.		
8	36. 2	54.31	29.98	72	73	N. E. fine breeze, flying clouds with frequent showers.		
9	36.41	57.42	30. 7	73	72	S. E. fresh, with a cloudy sky, and humid.		
10	36.52	59.50	29.95	73	74	W. light and squally, frequently shifting, and through the day changing round the compass.		

Concluded.

Winds, and state of the Weather, &c. &c.

	June and July 1821	Lat.	Lon. W.	Barom.	Ther. in air.	Ther. in water.	
♂	11 36.23	60.33	30.	74	73	W. by N. light and squally, with rain.	
♀	12 36.11	61.44	29.93	77	76	S. W. by W. variable and clear.	
♂	13 36.32	62.47	30. 4	74	77	N. W. by W. light airs clear dry weather, with an agitated sea.	
♂	14 37.14	63. 7	30. 1	73	77	E. N. E. light, in the Gulf-Stream, toward evening temp. of water 71 to 80.	
♂	15 38.10	64.15	30.18	75	80½	N. N. E. light, thin clouds, hazy, inclining to clear.	
♂	16 39.37	63.99	30. 3	75	76	E. light and sky hazy.	
♂	17 41. 3	64.28	29.98	75	74	{ E. fine breeze, almost clear, temp. of water from 74 to 68 sounded in 100 fathoms, on St. George's bank.	
♂	18 41.59	66.33	29.77	64½	58	{ S. S. W. fresh, cloudy, and rain, very gloomy, fell in with fishing boats.	
♀	19 42.26	67.21	30. 1	64	60	{ W. S. W. light, a mackerel sky, accompanied by quantities of fish.	
♀	20 42.21	68.91.	30. 1	65½	63	{ S. S. W. cloudy and foggy, caught from daylight till 12 o'clock upwards of 12,000 mackerel.	
♂	21 42.24	69.30	30. 8	73½	67	{ S. S. E. light breeze, saw the land!!! Cape Cod.	
♂	22					Arrived this morning off the light—came to anchor owing to fog in 31 fathoms, remained an hour, got under weigh, received a pilot at 11 A. M. at 3, past through the entrance to the harbor, struck the middle grounds and remained half an hour, got off and proceeded up to town, and came to anchor off Long Wharf about 5 P. M. after a passage from Gibraltar of 47 days.	

Winds, and state of the Weather, &c. &c.

ART. XVIII.—*Description of the Apparatus used in lighting the Tron steeple Glasgow, with Gas—see the plate.*

[Communicated to the Editor, by a gentleman in Glasgow.]

C is a lamp in which the gas is burned. Externally it is concealed by the figure of an eagle, internally it has a door containing five panes of glass, glazed convexly. Within the lamp, and behind the flame, the surface is covered with pieces of mirror plate so as to form a parabolic reflector, from which the rays diverge upon the dial plate of the clock **D**. At the top of the lamp is a funnel for the smoke.

A is the gas pipe by which the lamp is fed. It is at the same time the principal support of the lamp.

B is a flash pipe by which the lamp is lighted; and it acts at the same time as a bracket to strengthen the pipe **A**. This pipe is cut with cross apertures in the side at short distances from each other, extending from the body of the steeple to the burner. At figure second is a section of the flash pipe, showing the cuts in the side, and a covering which projects over them to protect them from rain. **D** fig. 2. shows a transverse section of the pipe and the covering. **A** and 2 show the cuts **C**, and the cover **B**.

After the gas has been let on by both pipes, a light is applied externally to the flash pipe, the gas rushing in jets through the apertures, kindles, and the flame communicating from one to another reaches the burner within the lamp. As soon as the gas passing through the burner is inflamed, the stop cock of the flash pipe is shut, the jets are of course extinguished, and the lamp continues to burn fed by the other pipe.

E and **F** are air-tight hinges in the two pipes, so contrived that by means of the chains **G G**, the lamp is drawn up by a person standing within the balcony of the steeple, beside **H**, the City Arms, *in alto relievo*, the burner, the glass, and the parabolic reflector, are thus cleaned every day, from the smoke or condensation of vapour which may have accumulated during the preceding night.

By the side of the pipes there is a good deal of scroll work acting as lateral brackets to strengthen them, which could not have been introduced into the drawing without confusing it.

The lamp is lighted every afternoon a few minutes before sun-set and at day-light the next morning it is extinguished by the machinery of the clock as represented in figure 3.

G is the main pipe by which gas is supplied to the lamp.

C is the stop cock, opened and shut by the lever B, at present open.

D is a wheel upon the spindle of the hour hand of the clock, making two revolutions in twenty four hours.

E a wheel moved by the other of double the diameter, and of course making one revolution in the same time.

H the beam of wood which supports these.

Upon the wheel E is a moveable index F, which is set about once a month, to correspond with the sun's rising. As the wheel revolves, a projecting knob at the end of this index, gradually reaches the upper end of the lever A, and presses it forward; this by moving disengages the lever of the stop cock B, which dropping downward by its own weight, falls into the position marked by the dotted lines I, and cutting off the supply of gas extinguishes the flame.

This plan of lighting steeples was the fruit of the joint labours of Messrs. J. & A. Harts and Mr. A. Liddell. The Messrs. Harts are operative bakers in Glasgow, who have distinguished themselves by their scientific attainments. Mr. Liddell is an ironmonger and his professional knowledge was found useful in the practical application of the plan. Messrs. Harts are found in their bake-house during the greater part of the day and their leisure hours are devoted to scientific and mechanical studies. They made the Camera Obscura in Glasgow Observatory, one of the largest in the kingdom, the speculum (a metallic one similar to those in Herschel's large Telescopes) about twelve inches in diameter, and the lens nearly as large were wholly prepared by themselves. They have in their bake-house a working model of the steam engine, (one of several, which they have constructed,) on a new plan which drives a turning lathe in the apartment above, and they have constructed a very superior reflecting telescope six feet in length. Lately they have made some curious discoveries in the art of staining glass. Their scientific knowledge is unaccompanied by the slightest degree of pride or ostentation, and they continue to labour as diligently at their trade as if they knew no higher pleasure.

ART. XIX.—Longitude of New-York ascertained by the observations of Prof. JAMES RENWICK.

Columbia College, New-York, Feb. 25th, 1822.

TO PROF. SILLIMAN.

Sir,

I beg leave to communicate, for publication in your valuable journal, my observation of the Solar Eclipse of 27th August last.

The observation was made from the cupola of the College in latitude $40^{\circ} 42' 45''$, N, as deduced from a number of observations made by my colleague Dr. Adrain.

The instruments made use of were an Achromatic Telescope by Dollond of four feet focal distance, a box-chronometer by Wingham, (London) and a pocket-chronometer by Morrice, (London.) The rates of both time keepers had been carefully noted for some time previous, and their error was observed by means of transits of the sun on the preceding and following day. This part of the preparation was performed by Messrs. T. & B. Demilt, watch makers of this city, who have erected an observatory and provided themselves with a transit and an excellent astronomical clock.

With these instruments the times of beginning and end, were as follows, viz.

					days. hrs.
Beginning—Apparent time at New-York.					
1821.	August.	-	-	-	26.19.37'.32"
End	do.	do.	do.	do.	26.22.20'.58"

The morning was by no means favorable, I was in consequence prevented from taking a set of altitudes, that might have enabled me to state the time from my own observations.

The view of the beginning of the Eclipse was as favourable as I could have desired, the clouds cleared for a few minutes from the sun's face, and my preparatory projection was so far accurate as to enable me to have in the centre of the field of the telescope the exact point of impact.

With regard to the end, the clouds had by that time accumulated to such a degree as to compel me to remove the

dark glass from the telescope and I had to contend with alternations of partial observation and intense light.

From the above observation, by a cursory calculation for the accuracy of which I cannot fully vouch, I make the longitude of the Cupola of Columbia College $74^{\circ} 5' 11''$ or in time 4hrs. 56.' 23." 4 W. from Greenwich. The mean of a number of Chronometers makes it about $74^{\circ} 8' W.$ and the Longitude given upon Eddy's Map is $74^{\circ} 0' 45'' W.$

I am Sir,

Your most obedient Servt.

JAS. RENWICK.

ART. XX.—*Notice of the Revolving Steam Engine ; by*
J. L. SULLIVAN, Esq.

Columbia, S. C. March 1, 1822.

Mr. Silliman—Sir,

HAD I no other motive to offer you a further communication on *Morey's Steam Engine*, I should think it due to your Journal, in which an account of this form of the machine had been given to the public at an early period, to state the fact of its successful employment ; but I find a farther reason for doing so in the opinion expressed by Ward in your 4th volume, while describing *his* invention. He fears that Morey's engine will not be durable, because, as he thinks, the friction between the parallel guides and the brasses that move on them, will be such, as to affect the parallelism of the piston-rod. This was to assume, that it would be impracticable to apply any anti friction substance to this part of the machine. But in practice, nothing was easier than to attach to each side an *oil-box*, with a few small holes in the top thereof, covered with a sponge, which as the engine revolves imbibes the oil, while the brass at each stroke reaches, and a little compresses this sponge, so that the steel guide pieces, are continually lubricated. And thus far it has performed satisfactorily, ascending the Santee and Congaree, towing heavy loads against a strong current. We call the steam boat, in which this engine operates the patent, in allusion to her claim, or right to navigate the waters of New-York, notwithstanding the monopoly granted by the

state, it being an admitted point, that the laws of the United States are the paramount authority. Wherefore, patented operations cannot be legally excluded.

But Mr. Ward's apprehension is shewn to be unfounded, by the performance of an engine of this kind during the last three years, at a manufactory near Boston, even without this precaution.

Unwilling to occupy your pages with this familiar subject, I will only add, that it appears to have been the object of Mr. Watt's experiments, to *avoid the use of the crank* as involving the *necessity* of a fly-wheel, to which motion must be given, at some expense of power, at every stroke. If I am not mistaken, the double revolving engine, is effectively a rotary engine. It has no dead-point, and requires no fly-wheel; and it is so far different from those reciprocating engines, which work with a heavy beam, that the indispensable weight of the machine, has a degree of momentum, that contributes to the steadiness of its operation. It appears to me, that to produce the same effect, Mr. Ward must place two cylinders in each water wheel at right angles.

Since this occasion of addressing you occurs, permit me to avail myself of the opportunity, to describe a small improvement in the steam boiler, put in practice in this boat, to combine strength with horizontal extension, in order to offer a great proportional surface to the fire, and yet carry a light load of water.

I took the material, that would have made a boiler of eight feet diameter, seventeen feet long, and formed seven cylindrical vessels: having conical heads, terminating in flanches to which are attached, a cross connecting pipe, thus making one boiler of them. The steam rises from the centre of each into a common chamber, on which the safety valve, and throttle valve are situated. The support is from four semicircular irons, or arches, from which suspending irons descend, &c. The spaces between, are filled with brick. The flue passes under them above deck; its sides and floor are formed of water vessels, kept full by the surplusage of the supply pump, for which they prepare the water; under the grate, however, there is an air chamber formed of two thicknesses of sheet copper, the space between them being also supplied with water, this descends a few

feet into the hold, and its bottom forms a pan into which the cinders fall. The floor of the fire room is on this level, and being half above and half below the level of the deck, is open to the air.

When half full it contains about three hundred gallons, but the fire is in large proportion. The steam appears to form very quickly. The advantage of the conical head is, that instead of being the weakest, this is the strongest part of the boiler, and within rules of computation.

I am respectfully yours.

J. L. SULLIVAN.

ART. XXI—*Description of an improved Saw machine with sectional teeth for the purpose of manufacturing staves, heading, and siding ; with remarks on the machine, and the lumber manufactured by it ; by ROBERT EASTMAN, of Brunswick, Maine.*

Communicated by Professor Cleaveland, of Bowdoin College.

THIS machine consists of a frame about twenty four feet in length, and five in breadth ; and a carriage about twelve feet in length, and four in breadth. The carriage travels with iron trucks, grooved on their circumferences, which run upon iron slides bolted to the inner sides of the frame. An iron centre passes through one end of the carriage, and into the end of the log, and is one of the centres, on which it revolves. At the other end of the carriage, *where there are two cross pieces*, is an iron arbor, which receives the circular iron index with concentric circles of holes drilled at equal distances and corresponding to the different sizes of the logs to be manufactured into staves, heading, or siding. These holes are called the numbers of the index. On the end of the index arbor, inside of the carriage, is a square to receive a dog fitted to it, which is first driven into the end of the log, and then slipped on the square of the index arbor, by means whereof the index and log are firmly connected together, and both revolve on the index arbor and centre, which are kept in place by stirrup screws.

Near the middle of the frame is the main shaft, which is of cast iron, and runs on friction rollers, supported by stands

on the floor. On this shaft are the saw and sappers, which are firmly attached to it with screws. The sappers which are crooked pieces of iron, *steel edged*, with slits to set them at a greater or less distance from the centre, according to the width of the lumber to be manufactured, and partaking of a common motion with the saw *only at a less distance from the centre*, cut the sap off the log leaving the thick or outer edges of the lumber perfectly straight.

A band, passing round the main pulley, which is on the main shaft, and on a drum that runs under it, (*which may be driven by a horse, steam, or water power,*) gives motion to the saw, and sets the machine in operation. The saw has only section teeth, and is made of a circular piece of sheet iron or steel, about one eighth of an inch in thickness, containing usually but eight teeth which are set in the outer edge of the saw plate, being dove tailed and grooved in order to remain firm until worn out, when new ones may be set in the same plate.

Under the frame is a small shaft with a large pulley on it (inside of the frame) which is connected to the main shaft by a band; on the other end of this small shaft at the outside of the frame, is another small pulley, which is also connected by a band to the *feed pulley*, which is placed near the middle of the frame. On the inside face of this *feed pulley*, are two wheels; one of them containing eight cogs, is placed in the centre; the other, a squirrel wheel, contains fifty cogs on the inside of its rim pointing towards the centre. Another short shaft, containing two wheels of about eighteen cogs each, is placed near the middle of the frame; one of these wheels meshes into the rack under the carriage: the other is placed on the outer end of the shaft to be acted upon by the large and small wheels that are on the feed pulley, which causes the carriage to feed and return alternately by the different acting of the eight and fifty cog wheels on the 18 cog wheel, which not only reverses the motion, but, at the same time, gives a different speed to the travel of the carriage, in its feeding and returning. Thus, when the 8 cog wheel meshes into the 18 cog wheel, the carriage moves forward with a slow motion to feed the saw; when the cut is performed, the feed pulley with its contents drops, unmashes the 8 and mashes the 50 into the 18 cog wheel, which reverses and quickens the travel of the carriage in returning, as 50 is to 8. This motion of the ris-

ing and falling of the feed pulley, is effected by a lever with a small steel spring at each end of it; each spring has a catch to lock on a pin in the side of the frame, to hold the cog wheels in their mesh, when the carriage is feeding and returning. In the centre of the lever is a pin, which attaches it to the side of the frame, and is the fulcrum on which it works. On the top of this lever, are two wooden springs, which run from the centre to the end, a little rising, which forms an inclined plane.

A knob on the side of the carriage acts on the top of this wooden spring as the carriage is feeding and returning, and alternately unlocks the steel spring from the pin in the frame; and the wooden spring causes that end of the lever, where the knob is, to descend and the other to ascend and locks its steel spring on the pin in the frame again. The piece of wood, which contains the feed pulley, is attached to that end of the lever which comes at the middle of the frame, and causes it to ascend or descend at every travel of the carriage. An iron frame is bolted firm on the end cross piece of the carriage, which holds an iron hand with a steel pointer in it, which, by means of a steel spring, locks into the holes of the index, and keeps the log firm in its place, while the saw is performing its cut.

On the inside of the end cross piece of the frame, is a shifting iron, which is a horizontal bar of iron with an elbow, forming an acute angle on the outer end; on the inner end is another elbow, which turns down, forming a right angle, with a bar perforated with holes at suitable distances, to correspond with the numbers of the index; into the holes in the bar a steel pointer 7 or 8 inches in length, may be screwed, so as to enter the holes of the index. This iron can move horizontally, being supported with hook bolts, and is kept in place by a small spring acting on the inner end; and two guard screws, are set, so as to guide the large pointer into one of the holes of the index when the carriage and log return from the cut.

On the other side of the frame, where the outer end of the hand on the carriage passes is a small trip iron, that strikes on the outer end of the hand and unlocks its pointer from the index; at the same time, the large pointer, entering one of the holes of the index and the carriage, striking the acute angle of the shifting iron, give it a hor-

izontal motion inward, which causes the log and index to shift one number, when the shifting iron strikes the guard screw, *that* prevents its shifting more than one number at a time. The outer end of the hand being now relieved from the trip iron, its pointer enters a new hole of the index by means of the spring and the carriage again moves forward for another cut.

Thus it operates, without any aid except the power that drives it, until it cuts a tier of lumber entirely around the log, like the radii of a circle, leaving their thin edges attached to it. These are then taken off, and another tier cut in the same manner, that is, when the log is large enough to admit of two tiers.

References to the Plate.

Fig. 1. gives a top view of the machine with the log in it ready for working.

2. gives a side view of the same.

3. an end view of the same with a log as partly cut.

5. The Saw.

6. The Sapper.

7. The Hand-frame Spring and Hand.

8. The Shifting iron in two views.

9. The Setting iron.

10. The Trip iron.

11. The Trucks.

12. The Stands.

13. The Index.

Reference to the several Parts as put together.

AA. The Frame, which is made of timber about 8 by 14 inches and put together by screws.

BB. The Carriage, made of timber about 7 by 8 inches, put together by screws.

C. The Log as dogged and put into the machine.

D. Saw and Sappers.

E. Main Pulley and Shaft.

F. Feed Pulley and Shifting gear, which is connected to the rack, under the carriage.

G. Tightening Pulleys.

HH. Regulating Pulleys and Shaft.

II. Friction Rollers and Stands.

J. Index.

- K. Index, Shaft and Cog.
- L. Centre iron and Cog.
- MM. Iron Slides bolted to the sides of the frame for the trucks to travel upon.
- NN. Revolving Lever and Springs.
- O. Pin, which attaches the Lever to the sides of the frame, and is the Fulcrum on which it works.
- P. Knob on the side of the carriage, that works the shifting lever.
- Q. Hand-frame, Spring and Hand.
- R. Shifting Iron and Long Pointer.
- S. Setting iron, which is Bolted to the under side of the carriage, and strikes the acute angle of the Shifting iron, when the carriage returns to set.
- T. Trip Iron, which unlocks the hand from the Index, when the carriage returns to set.
- UU. Stirrup Screws.

Remarks, &c.

This machine furnishes a new method of manufacturing lumber for various useful purposes. Though the circular saw had previously been in operation in this country, and in Europe, for cutting small stuff, it had not, within the knowledge of the writer, been successfully applied to solids of great depth; to effect which the use of section teeth are almost indispensable.

In my first attempts to employ the circular saw for the purpose of manufacturing clap boards, I used one nearly full of teeth, for cutting five or six inches in depth into fine logs. The operation required a degree of power almost impossible to be obtained with the use of a band; the heat caused the plate to expand, and the saw to warp, or, as it is termed, to get out of true. To obviate these difficulties I had recourse to the use of section teeth, and the improvement completely succeeded. The power required to perform a given quantity of work by the other method, was, by this, diminished at least three quarters. The work, formerly performed by 70 or 80 teeth, was by the last method performed by 8 teeth; the saw dust, which before had been reduced to the fineness of meal, was coarser, but the surface of the lumber much smoother, than when cut with the full toothed saw.

The teeth are made in the form of a Hawk's bill, and cut the log up, or from the circumference to the centre.

The saw may be carried by an eight inch band, when driven a proper speed, (which is from ten to twelve hundred times per minute,) will cut nine or ten inches in depth into the hardest white oak timber with the greatest ease. The sappers at the same time cut off from one to two inches of the sap, and straighten the thick edges of the lumber.

The facility with which this saw will cut into such hard materials may be supposed to result from the well established principle that where two substances in motion come in contact, their respective action on each other is in direct proportion to their respective velocities; thus, a circular plate of iron, put into a quick rotary motion, will with great ease penetrate hardened steel, or cut off a file, when applied to its circumference; and the same principle is applicable to a rotary saw for cutting wood. The requisite degree of velocity is obtained by the continuous motion of the circular saw; by which also it has greatly the advantage of one that has but a slow motion on account of dulling, as the teeth are but little affected, and being only eight in number, but a few moments labour is required to sharpen them. If the velocity of the saw were slackened to a speed of but 40 or 50 times per minute, it would require at least four such bands to carry it through a log as above described.

One machine will cut from 18 to 20 hundred square feet of pine timber per day, and two of them may be driven by a common tub wheel 7 or 8 feet in diameter, having 6 or 7 feet head of water, with a cog wheel, and trundle head so highly geared, as to give a quick motion to the drums, which should be about four feet in diameter. The machine is so constructed, as to manufacture lumber from 4 to 10 feet in length, and from two to ten inches in width, and of any required thickness.

It has been introduced into most of the New England states, and has given perfect satisfaction. The superiority of the lumber has for three years past been sufficiently proved in this town (Brunswick, Me.) where there have been annually erected from fifteen to twenty wooden buildings, and for covering the walls of which, this kind has been almost universally used. The principal cause of its superiority to mill sawed lumber, is in the manner in which it is manufactured, viz: in being cut towards the the centre of the log, like the radii of a circle; this leaves the lumber feather

edged in the exact shape in which it should be, to set close on a building, and is the only way of the grain, in which weather boards of any kind can be manufactured to withstand the influence of the weather, without shrinking, swelling, or warping off the building. Staves, and heading also, must be rived the same way of the grain in order to pass inspection. The mill sawed lumber, which, I believe, is now universally used in the middle and southern states, and in the West-Indies, for covering the walls of wooden buildings is partly cut in a wrong direction of the grain, which is the cause of its cracking and warping off, and of the early decay of the buildings by the admission of moisture. That such is the operation may be inferred by examining a stick of timber which has been exposed to the weather: the cracks, caused by its shrinking all tend towards the heart or centre, which proves that the shrinking is directly the other way of the grain. It follows that lumber cut through or across the cracks would not stand the weather in a sound state in any degree to be compared with that which is cut in the same direction with them. I have no hesitation in stating that one half the quantity of lumber, manufactured in this way, will cover, and keep tight and sound the same number of buildings for an hundred years, that is now used and consumed in fifty years. Add to this the reduction of expense in transportation, and of labour in putting it on, and I think every one must be convinced, that the lumber manufactured in this improved way is entitled to the preference.

In manufacturing staves and heading, a great saving is made in the timber, particularly as to heading, of which at least double the quantity may be obtained by this mode of sawing to what can be procured in the common method of riving it; nor is the straight grained, or good rift indispensable for the saw, as it is for the purpose of being rived. The heading, when sawed, is in the form it should be, before it is rounded and dowed together, all the dressing required, being merely to smooth off the outsides with a plane. Timber for staves ought to be straight in order to truss, but may be manufactured so exact in size as to require but little labour to fit them for setting up.

Both articles are much lighter for transportation, being nearly divested of superfluous timber, and may be cut to any thickness required for either pipes, hogsheds, or flour barrels.

Brunswick, Me. April 4, 1822.

ART. XXII.—*Formation of flexible, elastic tubes ; by Mr. THOMAS SKIDMORE.*

FOR THE JOURNAL OF SCIENCE.

Mr. Editor,

I HAVE lately had occasion, in the practice of the arts, to make use in a modified manner, of the compound blow-pipe of Hare, supplied with oxygen and hydrogen gases ; and in doing so, have been compelled to seek for some material of which I could make a flexible elastic hose or tube, indispensable to my operations.

Leather in various ways, was used without success. The intestine of the hog, and the bullock—in their natural state, answered a tolerable purpose, for a short time, but they soon cracked and exhibited fissures, through which the gasses escaped very fast—and on being tanned with an infusion of sumach, became very porous, notwithstanding they were surcharged with oils, tallow, &c.

At last I imagined that caoutchouc, or India rubber, might be employed with a prospect of success ; and as I obtained it, I trust it may possibly be of some importance to some of your readers, to be made acquainted with the process, I pursued in its manufacture—the detail of which follows and is at your disposal.

I caused small iron wire to be coiled spirally around a cylindrical rod of iron, as close as it could be laid, of the length, in one instance of twelve feet. The extremities of this spiral coil were then made fast to the rod, (after having been once loosened from it) in manner, such, that, in the subsequent operations, the convolutions of the wire should remain in contact with each other. Over this spiral coil was wound in a similar manner, a covering of tape, ferreting, or other fabric, so as to completely invest it, and, in a process which is shortly to follow, to prevent the intrusion of the gum to be used, into the cavity of the spiral coil before mentioned.

The rubber is now taken, I mean such kind of it as is sold in the form of bottles, and cut into long, narrow strips, like carpet rags. This is best effected by cutting them originally into two equal parts, and then reducing them, as near as may be, into the shape of a circular plate, with a pair of sharp tailor's shears, which succeeds in such case

much better than would commonly be imagined. These strips are wound over the covering of tape, or ferreting above mentioned, in a spiral manner from one end of the coil to the other, and this, in my instance was twice repeated—care being taken to lay, as far as practicable, the fresh cut surfaces in contact with each other, drawing them so tightly, as to cause them, from their elastic property, to stretch to two, three or four times, their ordinary length. When this was done, another covering of strong tape (linen is to be preferred) was laid likewise spirally over, or around the same from end to end—and secured upon it, by very strong twine laid as closely as could be done, and drawn as tightly as the material would permit. The rod of iron was next withdrawn—the recently formed hose was then so far bent into a circular form as to be received into a vessel of water in which it was boiled for an hour or two, when it was taken out, the external covering taken off, and the internal wire and tape withdrawn.

This latter operation, at first gave me some trouble, in consequence of the stiffness of the wire—but, in preparing other tubes of the kind, this difficulty was overcome by annealing the wire, previous to commencing operations.

In the course of my little practice in pursuit of this object, I found that if the hose so prepared, be, for any purpose subjected to a second boiling, it has the effect of reducing the size of the hose considerably, so that if this second boiling be even intended, though I know of no reason to desire it unless it be to unite two pieces of hose together, this circumstance should be taken into the account.

I know very well that hose or tubes, of this material, made upon glass or metal rods, are stated to have been fabricated—yet as I was unable to succeed in that way in specimens exceeding four inches in length, I concluded, that where twice or thrice that number of feet were wanted, the method was impracticable, and therefore pursued the one I have detailed. It resulted in a hose, perfectly elastic, as you may well conceive, and though not very elegant on its exterior, yet very light, and perfectly impervious to the gases it conducts to the blow-pipe to which it is attached.*

I am, Sir, yours, &c.

THOS. SKIDMORE.

* Note—A specimen of the tube is in our possession, and perfectly answers the description.—[Ed.]

ART. XXIII.—*Notice of a singular impression in sand stone,* by Mr. ISAAC LEA.*

PHILADELPHIA, Feb. 24, 1822.

PROFESSOR SILLIMAN.

Dear Sir,

On looking over my port folio a few days since, I found a drawing of some reliquia which I made a few years since, when I observed them about a quarter of a mile above Pittsburgh, and on the same side of the Monongahela.

With this I send you a copy of the drawing, which you will please to insert in the Journal of Science, if you think it worthy of a place in that useful work. I am more anxious to see this figure in a permanent place, as on a late visit to it I found the dilapidating hammer of the quarry-man, to be likely to remove from its native bed, and destroy one of the most singular specimens of the kind which I have ever seen, and respecting which, the learned find so much difficulty in deciding whether it belongs to the animal or vegetable kingdom.

The impression is very perfect on a sand stone rock, and entirely flat. The base is perfectly terminated in the rock and is about six inches across; its length three feet, and terminated by a fracture of the rock, which leaves it doubtful how long it may have been in its pristine state; at this fracture it is four inches broad. The two lines are distinct in both lozenge shaped impressions, which are represented of the natural size in fig. 2d. [See the plate at the end.]

The hill in which it exists is not sufficiently high to take in the bed of coal pervading the neighbouring hills in a horizontal stratum about two hundred and fifty feet above this locality. In fragments of the same rock, are found many impressions resembling culmiferous plants, the joints of which are perfect. Some of them are now in my own collection, others I deposited, particularly a large one, in the "Academy of Natural Science."

Your obedient servant,

ISAAC LEA.

* Note—This article should in strictness, have been placed under the Geology, &c. but having been accidentally omitted, is inserted here.

ART. XXIV.—*On the twinkling of the Fixed Stars.**New-Haven, January 20, 1822.*

MR. SILLIMAN,

Sir,

IN perusing Bonnycastle's Introduction to Astronomy, I was struck with the following solution of the phenomenon of the scintillation, or twinkling of the fixed stars. Page 42d, he says, "the fixed stars are distinguished from the planets by being more bright and luminous, and by continually exhibiting that appearance which is called the scintillation or twinkling of the stars. This probably arises from their appearing so extremely small, that the interposition of any minute substance, of which there are many constantly floating in the atmosphere, deprives us of the sight of them; but as the interposed body soon changes its place, we again see the star; and this succession being perpetual occasions the twinkling." Whether this be the commonly received opinion, on this subject, among astronomers, or not, I am not sufficiently conversant with their works to decide; but from its being assigned by so distinguished an astronomer as Mr. Bonnycastle, I conclude that it is one of the best that have been given. To my mind this solution is very unsatisfactory. Without farther proof of the fact, the existence of these floating substances in numbers, and of size sufficient to produce this phenomenon, is scarcely credible. But admit that they exist, why do they not produce similar phenomena in their transits over the faces of the planets? Farther, I apprehend that the effect of the interposition of these substances between the eye and the stars, which would be as Mr. B. observes, to deprive us of the sight of them, does not accord with the fact, or with the phenomenon of scintillation. In my view, the star does not disappear in its scintillations, but is constantly visible; and its twinkling seems to be the effect of successive emanations of light; resembling the waving of a blaze by the wind. Though but a novice in astronomy, I will suggest a conjecture on this subject, which, to my mind, is much more plausible; certainly less embarrassed with objections

than Mr. Bonnycastle's. It is supposed by astronomers, from the immense distances of the fixed stars, and the weakness of borrowed light, that they shine with their own light. May it not be owing to this fact, that they scintillate, or twinkle? would not their shining with their own light produce the difference, manifest in the appearance between them and the planets, which are known to shine with borrowed light? I am not able to point out with precision the difference between original, if I may so call it, and reflected light; but that there is a difference is very obvious. When looking at the sun with the naked eye, I can easily conceive, that were that body, which now, with its dazzling scintillations, compels me soon to turn away, removed at a suitable distance, it would exhibit to us the same phenomenon, as is now exhibited by one of the fixed stars. This subject is of some importance in connexion with the sublime idea that the fixed stars are suns to other systems, and I make the suggestion, with the hope that, if it be worthy of notice, it will receive a more satisfactory elucidation from an abler pen.

SCINTILLA.

MISCELLANEOUS.

ART. XXV.—*Original letters from Dr. Franklin, to the Rev. Jared Elliot of Killingworth, Con. concluded from Vol. IV. p. 357.*

6

PHILADELPHIA, DEC. 10, 1751.

Dear Sir,

THE Rector of our Academy, Mr. Martin, came over into this country on a scheme for making potash, in the Russian method. He promised me some written directions for you, which expecting daily, I delayed writing, and now he lies dangerously ill of a kind of quinsy. The surgeons have been obliged to open his wind-pipe, and introduce a leaden pipe for him to breathe through. I fear he will not recover.

I thank you for the merino wool; 'tis a curiosity. Mr. Roberts promises me some observations in husbandry for you. It is one Mr. Martin that makes dung of leaves, and not Mr. Roberts: I hope to get the particulars from him soon.

I have a letter from Mr. Collinson of July 19, in which he writes, "Pray has Mr. Elliot published any addition to his work; I have No. 1 and 2. If I can get ready, I will send some improvements made in the sandy parts of the County of Norfolk; by the way it is a *great secret*, but it is Mr. Jackson's own drawing up, being experiments made on some of his father's estates in that County: but his name must not be mentioned. I thank you for the fowl meadow grass. I sowed it June 7, as soon as I received it, but none is yet come up. I don't know how it is, but I never could raise any of your native grasses; and I have had variety of J. Bartram of curious species."

In another of Sept. 26, he says, "I am much obliged to thee for Mr. Elliot's third essay. I have sent Maxwell's select transactions in husbandry: if Mr. Elliot has not seen them, they may be very useful to him. I have prevailed on our worthy, learned, and ingenious friend, Mr. Jackson, to give some dissertations on the husbandry of Norfolk, believing it may be very serviceable to the Colonies. He has great opportunities of doing this, being a gentleman of leisure and fortune, being the only son whose father has great riches and possessions, and resides every year all the long vacation at his father's seat in Norfolk. After J. Bartram has perused it, I shall submit how it may be further disposed of, only our friend Elliot should see it soon; for Mr. Jackson admires his little tracts of husbandry as well as myself, and it may be of greater service to him and his Colony, than to yours." The fowl meadow grass has at last made its appearance. Another year we shall judge better of it."—Thus far friend Collinson, you may expect the papers in a post or two. If you make any use of them, you will take care not to mention any thing of the author.

The bearer is my son, who desired an opportunity of paying his respects to you in his return from Boston. He went by sea.

They have printed all my electrical essays in England, and sent me a few copies, of which I design to send you one per next post, after having corrected a few errata.

I am, dear Sir,

Your most humble servant,

B. FRANKLIN.

Mr. Martin is dead !

7

PHILADELPHIA, Dec. 24, 1751.

Dear Sir,

I wrote you at large per my son, in answer to your former favours, and sent you an extract of Mr. Collinson's letter, who much admires your tracts on husbandry. Herewith you will receive a manuscript of a friend of Mr. Collinson's, and a printed book ; which you may keep till spring, and then return to me. I believe they will afford you pleasure.

I send you also enclosed a letter from my friend John Bartram, whose journal you have read. He corresponds with several of the greatest naturalists in Europe, and will be proud of an acquaintance with you. I make no apologies for introducing him to you ; for though a plain illiterate man, you will find he has merit. And since for want of skill in agriculture, I cannot converse with you pertinently on that valuable subject, I am pleased that I have procured you two correspondents who can.

I am glad you have introduced English declamation into your College. It will be of great service to the youth, especially if care is taken to form their pronounciation on the best models. Mr. Whittelsey who was lately here will tell you, that we have little boys under seven, who can deliver an oration with more propriety than most preachers. 'Tis a matter that has been too much neglected.

I am, dear Sir,

Yours affectionately,

B. FRANKLIN.

8

PHILADELPHIA, Feb. 11, 1752.

Dear Sir,

I received your favour per my son, and return my thanks for your kind entertainment of him at your house. I delivered yours to my friend Bartram, and enclose you his answer; he is much pleased with the prospect of a continued correspondence with you: is a man of no letters, but a curious observer of nature.

I like very well the paragraph you propose to insert concerning Mr. Jackson's papers; except the last line, to wit, *the improvement of it must be deferred till another year*; instead of which, I would say, *it cannot now be inserted but shall be in our next*. My reasons are, that I think in the first place, your essays ought to be more frequent than once a year; next, that 'tis pity, if Mr. Jackson's papers would be advantageous to the public, a whole year's benefit of them should be lost; thirdly, I think he will be at a loss to know why, since your essay was not quite finished and published, his papers might not as well have been added now; and indeed I think you had best add them, unless you intend speedily another essay. Lastly, I object to the word *improvement*, which in the sense you use it is peculiar to New-England, and will not be understood elsewhere. It will look as if you proposed to alter it for the better, correct or amend it, such being the common meaning of the word *improve*. Every Colony has some peculiar expressions, familiar to its own people, but strange and unintelligible to others. But this is not to be wondered at, since the same may be observed in the different Counties of England. I know you will excuse this freedom, and that I need make no apology for it.

I am, with great respect, dear Sir,

Your most humble servant,

B. FRANKLIN.

9

PHILADELPHIA, Dec. 19, 1752.

Dear Sir,

I received your affectionate letter of the 1st. and am surprised to find that my letters do not of late get to your hand. I do not keep copies, but I remember well, that in one. I

acknowledged the receipt of the select transactions, and in another I complained of the long delay of your fourth Essay, and desired that if Mr. Green would not do it, you would send it to me, and it should be despatched in a trice. To this I own I have long wondered that there came no answer; but now the reason appears you never received it. I am not indeed the most punctual of correspondents, but am however less negligent than I have of late appeared to you to be. To converse in this manner with my friends is one of my greatest pleasures; but much business does sometimes interfere and occasion delays, which makes me more ready to excuse others, as I have frequent occasion to be excused. At present however, I am not to be blamed, but some defect in the conveyance, which I cannot now guess at; but to prevent the miscarriage of this, I send it under cover to Dr. Johnson, and request him to forward it by some safe hand, for having exchanged many letters lately with that gentleman on occasion of my printing his book, and not observing any of them to miscarry, I have reason to expect this will at least get safe as far as Stratford.—By the way, are you not a letter in debt to our friend Bartram? If not I fear a long one of his to you, enclosed in one of mine has miscarried also.

Our friend Mr. Jackson wrote to me last year, for an account of the number of Palatines imported here within ten years, which I accordingly sent him, and accompanied it with a sheet or two on the subject of peopling of countries, propagation of mankind, &c. in answer to which I have lately received a long and curious letter from him, which I will send for your perusal together with my paper, as soon as I find it can be done without danger of being lost.

In the mean time, I send you a meteorological paper of mine, wrote in order to digest and methodise a few of my own thoughts, and to procure the corrections of my Friends, I beg your sentiments and criticisms, on such parts as you find wrong; and if you can give me any light into the nature of those meteors we commonly call *falling stars*, pray do; for I am extremely at a loss to know what to think of them. Also any thing that has come to your knowledge of the nature and effects of whirl-winds and water-spouts; concerning which I have seen only imperfect accounts.

I know you will be pleased to hear that our Academy flourishes, and therefore I inform you that we have now

upwards of 300 scholars in all the schools. Our Hospital too, goes on very well, and does much good. We have this day been opening our cargo of choice Drugs and Medicines from London, that cost us 112£ sterling; and find all in good order. I must not omit to acquaint you with one other instance of the public spirit of this people. A person who had been in the last expedition to discover a north-west passage, being fully persuaded from some observations he made, and notices he obtained there, that such a passage there probably is, wrote to me from Maryland, requesting I would endeavor to procure subscriptions here for another attempt. It is accordingly done; 1000£ is raised for the purpose, and a vessel is actually fitting for him to proceed in early in the Spring. If you have any queries to make concerning that Country, its Productions, &c. or would have any particular observations made there; write them, and I will send them by our captain who is an ingenious and observing man.

Did you receive the votes of our last years Assembly, which I sent you, as I think; but am not very certain. I know I intended it.

And now my paper will only afford me room to add, that I have not received more pleasure and satisfaction from any correspondence I maintain, than from that you have favoured me with; which I hope will never again meet such interruption, as I am, with sincere esteem and affection, dear Sir, your obliged friend and servant,

B. FRANKLIN.

10

PHILADELPHIA, April 12, 1753.

Dear Sir,

I received your favor of March 26, and thank you for communicating to me the very ingenious letter from your friend Mr. Todd, with whom, if it may be agreeable to him, I would gladly entertain a correspondence. I shall consider his objections till next post.

I thank you also for the hint concerning the word *adhesion*, which should be defined. When I speak of particles of water *adhering* to particles of air, I mean not a firm adhesion, but a loose one, like that of a drop of water to the end of an icicle before freezing. The firm adhesion is after it is frozen.

I conceive that the original constituent particles of water are perfectly *hard, round and smooth*. If so, there must be interstices, and yet the mass incompressible. A box filled with small shot, has many interstices, and the shot may be compressed, because they are not perfectly, hard. If they were, the interstices would remain the same, notwithstanding the greatest pressure, and would admit sand, &c. as water admits salt.

Our vessel, named the *Argo*, is gone for the north-west passage; and the Capt. has borrowed my journals of the last voyage, except one Vol. broken set, which I send you. I enclose a letter from our friend Mr. Collinson: and am promised some speltz which I shall send per next post.

The *Tatler* tells us of a girl who was observed to grow suddenly proud, and none could guess the reason, till it came to be known that she had got on a pair of new silk garters. Lest you should be puzzled to guess the cause when you observe any thing of the kind in me, I think I will not hide my new garters under my petticoats, but take the freedom to show them to you, in a paragraph of our friend Collinson's last letter, viz.—But I ought to mortify, and not indulge this vanity.—I will not transcribe the paragraph.—Yet I cannot forbear.—“If any of thy friends (says Peter,) “should take notice that thy head is held a little higher up than formerly, let them know; when the Grand Monarch of France strictly commands the Abbe' Mazeas to write a letter in the politest terms to the Royal Society, to return the king's thanks and compliments in an express manner, to Mr. Franklin of Philadelphia, for the useful discoveries in Electricity, and application of the pointed rods to prevent the terrible effects of thunder storms: I say after all this, is not some allowance to be made if the crest is a little elevated. There are four letters containing very curious experiments on thy doctrine of Points and its verification, which will be printed in the *New Translations*. I think now I have stuck a feather in thy cap, and I may be allowed to conclude in wishing thee long to wear it.

Thine

P. COLLINSON.”

On reconsidering this paragraph, I fear I have not so much reason to be proud as the girl had; for a feather in the cap, is not so useful a thing, or so serviceable to the wearer, as a pair of good silk garters. The pride of man is very differ-

ently gratified, and had his majesty sent me a Marshall's staff, I think I should scarce have been so proud of it as I am of your esteem, and of subscribing myself with sincerity, dear Sir,

Your affectionate friend, and
humble servant,

B. FRANKLIN.

11

PHILADELPHIA, May 3, 1753.

Dear Sir,

I received your essay last post, and my presses being at present engaged in some public work that will not admit of delay, I have engaged Mr. Parker to print it out of hand at New-York. You may expect to see it done in two or three weeks. The packet was not sealed, and I observed that the tables showing the culture of sundry fields were not with the rest of Mr. Jackson's papers. Perhaps you did not design them for the press.

I wish the Barbary barley may grow. I have some of it and sowed it; but it seemed to me to have been cut too green. I have formerly heard it reckoned the finest barley in the world, and that it makes a great part of the food of the inhabitants.

I think I have never been more hurried in business than at present; yet I will steal a few minutes, to make an observation or two on Mr. Todd's ingenious letter to you.

1. The supposing a mutual attraction between the particles of water and air, does not seem to me to be introducing a new law of nature; such attractions taking place in many other known instances.

2. Water is specifically eight hundred and fifty times heavier than air. To render a bubble of water then specifically lighter than air, it seems to me that it must take up more than eight hundred and fifty times the space it did before it formed the bubble; and within the bubble should be either a vacuum, or air rarified more than eight hundred and fifty times. If a vacuum, would not the bubble be immediately crushed by the weight of the atmosphere? And no heat we know of will rarify the air any thing near so much; much less the common heat of the sun, or that of friction by the dashing on the surface of the water. Be-

sides, water agitated ever so violently produces no heat, as has been found by accurate experiments.

3. A hollow sphere of lead, has a firmness and consistency in it, that a hollow sphere of fluid unfrozen water cannot be supposed to have. The lead may support the pressure of the water 'tis immersed in, but the bubble could not support the pressure of the air if empty within.

4. Was ever a visible bubble seen to rise in air? I have made many when a boy with soap suds, and a tobacco pipe; but they all descended when loose from the pipe, though slowly, the air impeding their motion. They may indeed be forced up by a wind from below; but do not rise of themselves though filled with warm breath.

5. The objection relating to our breathing moist air, seems weighty, and must be farther considered. The air that has been breathed has doubtless acquired an addition of the perspirable matter, which nature intends to free the body from, and which would be pernicious if retained, or returned into the blood. Such air then may become unfit for respiration, as well for that reason, as on account of its moisture. Yet I should be glad to learn by some accurate experiment, whether a draft of air two or three times inspired and expired, (perhaps in a bladder) has, or has not acquired more moisture than our common air in the damp weather.

As to the precipitation of water in the air we breathe, perhaps it is not always a mark of that air's being overloaded. In the region of the clouds, indeed, the air must be overloaded (its coldness considered) if it lets fall its water in drops, which we call rain; but those drops may fall through a dryer air near the earth; and accordingly we find, that the hygroscope sometimes shows a less degree of moisture during a shower, than at other times when it does not rain at all. The dewy dampness that settles on the insides of our walls and on our wainscots, seems more certainly to denote an air overloaded with moisture, and yet this is no sure sign. For after a long continued cold season, if the air grow suddenly warm, the walls, &c. continuing their coldness longer, will for some time condense the moisture of such air, 'till they grow equally warm; and then they condense no more, although the air is not become dryer. And on the other hand, after a warm spell, if the air grow cold, though moister than before, the dew is not

so apt to gather on the warm walls. A tankard of cold water, will, in a hot and dry summer's day, collect a dew on its outside. A tankard of hot water will collect none in the moistest weather.

6. 'Tis, I think, a mistake, that the trade winds blow only in the afternoon. They blow all day, and all night, and all the year round, except in some particular places. The southerly sea breezes on your coast indeed blow chiefly in the afternoon. In the very long run from the west side of America, to Guam among the Philippine islands, ships seldom have occasion to hand their sails, and yet they make it in about sixty days, which could not be if the wind blew only in the afternoon.

7. That really *is*, which the gentleman justly supposes ought to be on my hypothesis. In sailing southward, when you first enter the trade wind, you find it N. E. or thereabouts, and it gradually grows more east as you approach the line. The same observation is made of its changing from S. E. to E. gradually, as you come from the south latitudes to the equator.

I have not yet had time to transcribe my paper on the increase of mankind, but hope to do it shortly, and shall be glad of your and Mr. Todd's sentiments on it. My respects to that gentleman; and be assured that I am, very affectionately, dear Sir,

Your most humble servant,

B. FRANKLIN.

12

PHILADELPHIA, Nov. 8, 1753.

Dear Sir,

THE first intimation I find of the new air-pump, is in a piece of Mr. Watson's, read to the Royal Society, Feb. 20, 1752, where describing some experiments he made in vacuum, he says—"The more complete the vacuum, *ceteris paribus*, the more considerable were the effects; and here, I should not do justice to real merit, were I silent in regard to Mr. Sweeton. This gentleman, with a genius truly mechanical, which enables him to give to such philosophical instruments as he executes, a degree of perfection scarce to be found elsewhere; this gentleman, I say, has construc-

ted an air-pump, by which we are impowered to make Boyle's vacuum much more perfect than heretofore. By a well conducted experiment, which admits of no doubt as to its truth, I have seen by this pump the air rarified to 1000 times its natural state ; whereas, commonly, we seldom arrive at 150. As the promotion of the mechanic arts is a considerable object of our excellent institution, if this gentleman could be prevailed upon to communicate to the Royal Society that particular construction of his air-pump, which enables it to execute so much more than those commonly in use, it would not fail to be an acceptable present." So far Mr. Watson. In April following, was read a letter from Mr. Sweaton, in which he describes his improvements, and gives a draft of his pump ; the whole too long to transcribe; but it appears to me that the machine being rather simplified, than more complex, can scarce cost more than one of the old sort, though the price is not mentioned. By only turning a cock, it is at pleasure made a condensing engine. An advantage the others have not.

I have seen nothing of your searchers.

Mr. Parker has received Bower, but writes me that he is at a loss how to send it, and desires you would order somebody to call for it.

I shall send the dollars for Mr. Mix, per next post. For I fancy you will not now buy this apparatus here, but chuse the new air-pump from England.

My respects to all friends, concludes from, dear Sir,

Your obliged humble servant,

B. FRANKLIN.

13

PHILADELPHIA, Aug. 31, 1755.

Dear Friend,

I have been employed, almost all this summer, in the service of our unfortunate army, and other public affairs, that have brought me greatly in arrear with my correspondents. I have lost the pleasure of conversing with them, and I have lost my labour : I wish these were the only losses of the year : but we have lost a number of brave men, and all our credit with the indians ; and I fear these losses may soon be productive of more, and greater.

I have had no opportunity of making the enquiry you desired, relating to Leonard. Somerset county, in Maryland, is 150 miles from hence, and out of the common road of travellers, or the post, nor have I any correspondent, or acquaintance there. But now, while I am writing, I recollect a friend I have at Newtown, within 50 miles of Somerset, who has a very general knowledge of those parts, and of the people, as he practices the law in all the counties on the eastern shore of Maryland : I will immediately write to him about it.

I am sorry your newspapers miscarry. If your riders are not more careful, I must order them to be changed.

The Mitchel who made the map, is our Dr. Mitchel. I send you one of Evan's new maps, which I imagine will be agreeable to you. Please accept it.

I am glad to hear your son has acquired the true art of making steel. I hope it will prove profitable.

Mr. Roberts is pleased that you so kindly accept his fork and rake. I suppose he will write to you ; but he is a man of much business, and does not love writing : I shall learn once more (for he told me once, and I forgot it) how those teeth are put in, and send you word ; but, perhaps, our friend Bartram can tell you. He delivers you this, and I need not recommend him to you, for you are already acquainted with his merit, though not with his face and person.-- You will have a great deal of pleasure in one another's conversation ; I wish I could be within hearing ; but that cannot be. He is upon one of his rambles in search of knowledge, and intends to view both your sea-coast and back country.

Remember me kindly to Mr. Tufts, and Mr. Ruggles, when you see them. My respects to your good lady and family

With the greatest esteem, I am, dear Sir,

Your most affectionate humble serv't.

B. FRANKLIN.

14

PHILADELPHIA, Sept. 1, 1755.

Dear Sir,

I wrote you yesterday, and now I write again. You will say, it cant rain, but it pours. For I not only send you

manuscript but *living* letters. The *first* may be short, but the *latter* will be longer and yet more agreeable. Mr. Bartram I believe you will find to be at least twenty folio pages, large paper, well filled, on the subjects of botany, fossils, husbandry, and the first creation. This Mr. Allison has as many or more, on agriculture, philosophy, your own catholic divinity, and various other points of learning, equally useful and engaging. Read them both. 'Twill take you at least a week; and then answer, by sending me two of the like kind, or by coming yourself. If you fail of this, I shall think I have overbalanced my epistolary account, and that you will be in my debt as a correspondent, for at least a twelve month to come.

I remember with pleasure the cheerful hours I enjoyed last winter in your company, and would with all my heart give any ten of the thick old folios that stand on the shelves before me, for a *little book* of the stories you then told with so much propriety and humour. Adieu, my dear friend, and believe me ever

Yours affectionately,

B. FRANKLIN:

Dr. ELLIOT.

P. S.—The piece of iron ore you mentioned in yours of April 10, never came to hand. I forgot to mention, that the bearer, Mr. Allison, is Rector of our Academy, and my particular friend. He is on a journey northward for health.

INTELLIGENCE AND MISCELLANIES.

I. Foreign.

(From a Correspondent.)

Prices of some minerals in London.—On looking over a marked catalogue of a sale by auction, of minerals in London, I was induced to copy a few items, which I send for your valuable Journal, as in this country, we often hear, even good mineralogists, express great surprise at the price

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demanded for small specimens in England, and as data for estimating the value of our own minerals.

Your's, F. L.

	£	s.	d.
A group of amethystine quartz, with pearl spar, Hungary,	0	4	6
A specimen of Haüy's petrosilex, from the river Argun, in Nertschinsky,	1	2	0
Carbonate of iron on quartz, Hartz, Topazine, Cubic Fluor, Gersdorff,		11	
Fascicular oxide of manganese, Hefeld, on the Harz,		7	6
Prismatic carb't. of lime, on Galenka, Cumber- land,		6	6
Transparent quartz, with chlorite, Brazil,		10	
Amianthoide, on Adularia, St. Gothard.	1		
Rose coloured fluor, Chamouni, in Switzer- land, and needle mesotype, Ferro,	1	10	
A single crystal of Arragonite, Molina.	1	8	
Chromate of lead, Beressoff.		12	6

From Thomson's Annals, for Nov. 1821.

"Lithography.—An experiment has lately been made to take off impressions from the leaves of plants, by lithographic printing. It appears to have been attempted by merely pressing the leaves against the stone. This process does not, however, appear the most adviseable; the better way being to cover the plant with the prepared ink, and after bringing a sheet of clean paper in contact with its entire surface, transfer the impression thus procured to the lithographic stone. We notice this from the great advantage which botanists are likely to derive from this simple mode of preserving and multiplying impressions from rare plants, which could otherwise, be seen only in the cabinets of a few collectors."

From Brandes' Journal.

"On meteorolites, by M. Fleuriau de Bellevue.—A paper by M. Fleuriau de Bellevue, was read to the Academy of Sciences last year, on meteoric stones, and particularly on those which fell near Jonzac, in the department of Cha-

rente." The following conclusions are presented as those drawn by M. Bellevue :

1. The appearances presented by the crust of meteorolites, seem to prove that their surface has been fused whilst rapidly traversing the flame of the meteor, and rapidly solidified into a vitreous state on leaving that flame.

2. They prove that in the first moments, the movement of the meteorolites was simple, that is, that they did not turn round on their own axis, whilst those two effects took place.

3. That the impulse each meteorolite has received has almost always been perpendicular to its largest face.

4. That the largest face is almost always, more or less, convex.

5. Our meteorolites (those of Jonzac) offer new proofs of the pre-existence of a solid nucleus, to bolides or meteors.

6. This nucleus could not contain the combustible matter which produced the inflammation of the meteor.

7. It cannot have suffered fusion during the appearance of the phenomena.

8. The gaseous matter, which surrounds this nucleus, is dissipated without producing any solid residuum. No trace of this matter appears ever to exist in the crust of the meteorolites.

9. Meteorolites are fragments of those nuclei which have not been altered in their natures, but simply vitrified at their surfaces.

10. Many of the irregular forms which these fragments present, may be referred to determinate geometric forms.

11. These latter forms are the consequences of the rapid action of a violent fire, according to a law of the movement of heat in solid bodies, discovered by M. Emen.

Jour. de Phys. xcii. p.159.

Foreign Literature and Science.

Communicated by Prof. Griscom.

1. *Human bones in a fossil state.*—Baron de Schlottheim, of Saxony, well known as the author of an *Antideluvian*

Flora, has just published a *catalogue raisonné et methodique* of his collection of fossils, the most complete perhaps in existence. Among other objects, he describes the *Anthropolites*, or fossil bones belonging to the human species, which have been discovered in the environs of Kostritz, near Gera, in the county of Recuss, in Upper Saxony. The rock on which the whole secondary stratum rests, is a *transition argillaceous schist*, of a reddish grey colour. It covers a hard firm grained *grau-wacke*, which occasionally makes its appearance in the beds of the streams. Immediately above this schist is old secondary limestone, in nearly horizontal strata. Old secondary gypsum is in some places inserted in the limestone, and is subordinate to it. An alluvium, composing a dryer soil, and occasionally sandy, covers all these secondary rocks. This soil which richly rewards the industrious cultivator, occupies an extent of many square miles. The secondary limestone is in many places cavernous, the cavities often containing numerous stalactites. Large openings, or cavities are also filled with the superincumbent clay. It is in one of the largest cavities of the limestone, and at the depth of twenty feet, and in the residue of the clay which fills the cavity, that the bones of large animals have been found. Among these bones are various fragments of the *Rhinoceros antiquitatis*, the jaws and teeth of a species of antediluvian horse, principally distinguished by the extraordinary length of its teeth. Vertebrae and tibiae of cattle, and stags of very extraordinary size. The lower jaw, and teeth of a large antediluvian hyena, (*canis crocutaformis major*, of Cuvier) fragments of the *leo diluvianus*. All these bones are, more or less, changed, and penetrated with calcareous matter; but as bones are found at much greater depths in clay, in some other places, and much less changed in their substance, it is admitted that a greater or less alteration of the substance of those fossil bones, cannot in any wise, serve as an indication of the difference that may exist in their relative ages; nor that the species to which they have belonged, have perished at different epochs.

The gypsum, which is subordinate to this cavernous limestone, presents itself in large uniform masses, or short thick beds inserted in the limestone. In these beds of gypsum, cavities, and fissures also exist, which extend themselves in

all directions, but of less dimensions than the limestone caverns. They are filled however, with the clayey alluvion, which descends to the greatest depths.

It is in these clayey masses which fill the crevices of the gypsum, that are found, collected in heaps or nests, and in circumstances perfectly similar, a multitude of bones of terrestrial animals, among which are evidently some of the *human species*. These plaster quarries have been open thirty years, during which these groups of bones have been found always imbedded in the same manner. The human bones are mingled with those of other animals, in detached pieces, and without forming an entire skeleton. In considering all the circumstances of their situation, it is fairly to be presumed, *that these human bones are really fossil remains, and contemporaneous with the other bones with which they are mingled; and that they have been driven and deposited by the waters, which have formed the alluvial stratum which covers the secondary rocks of this country; and consequently then, man existed prior to the formation of the alluvial earth, which resulted from the last great revolution which has changed the surface of the globe, and during which a northern climate, before unknown, became established.*

Mr. Cuvier has justly observed in his *researches*, Tome I, page 66, that this last epoch of the great inundation, which destroyed a crowd of animal species, whose remains are found only in alluvion, and in no rock more ancient, accords well with our chronology. The instructive facts now before us, seem to add fresh confirmation to the tradition of this inundation, a tradition which is preserved among all nations.

The principal parts of the human frame that have been thus obtained, are a frontal bone, with the half of the ophthalmic orbits, the left part of a male pelvis, the tibia of the left leg, and the right and left femur.

Bibliothique Universelle, Nov. 1820.

2. *Climate of the South of France.*—Dr. James Clark has published (London, 1820,) "*Medical notes on Climate,*" in which he appears to prove, that consumptive patients have no just reason to expect that benefit from the air of the northern shore of the Mediterranean, which so many are eager to seek for. The wind which blows from the mari-

time Alps, called the *mistral*, and which produces a sudden, and most unpleasant change of temperature, is of itself sufficient to discourage delicate, and phthisical patients from exposing themselves to its attacks. These winds in general, produce *hemoptisis* in those whose lungs are affected; even the physicians of Nice, who are strongly disposed to recommend that place to the sick, in the months of November, December, and January, acknowledge that the cold winds of the three following months are very unfavourable. But in the middle of winter it is very difficult for sick people to find the means of retreating from these warm, and comfortable quarters, without exposing themselves to the attacks of the *mistral*. Dr. Vodici, a very enlightened physician of Nice, said to Dr. Clark, "you may assure your colleagues, and countrymen that it is a miserable practice to send their consumptive patients to die at Nice. The English make this fatal trial every year, and the cemetery of *la Croix de marbre*, but too clearly attests the consequences.

Rev. Encyclopedique.

3. *Pressure of the atmosphere*.—Père Biseln, Prior of the hospital of mount St. Bernard, states that the atmospheric pressure is so diminished that water boils at a temperature of 78. 8. Reaumur, which renders it necessary to cook their meat from five, to five and a half hours, which on account of the scarcity of wood, is a serious inconvenience. In consequence of this, it has been proposed to supply those good monks with Papin's digester, as a remedy for this difficulty.

4. *Zoology*.—*New species of Salamander*.—Dr. Paolo Savi, adjunct professor of Botany, in the University of Pisa, has found in various places, in the Appenines of Tuscany, and especially at Mugello, a new species of Salamander, very remarkable from its figure, and colours, and endowed with characters so particular, that it appears hitherto to have been undescribed. He calls it *Salamandra perspicillata quinque palmis plantisque tetradactylis*. It has a spot in the superior part of the head, which resembles very nearly, a pair of spectacles. But what is still more characteristic, is the fact, that it has four toes on each foot: so that it cannot be confounded with the Salamander of three toes men-

tioned by Mr. Lacepede. (Hist. Nat. Tom. VI. pa. 496.) The detailed description of this new Salamander is given in the *Bibliotheca Italiana*, No. LXV. *Rev. Ency.*

5. *Meteorolite*.—There fell in the commune of Juvenas, France, on the 15th of June last, an Aerolite which weighed 220 pounds. The inhabitants of Juvenas, as well as those of the neighbouring country were so terrified with the frightful noise which accompanied its fall, that it was not until the 28th of the month that any one dared to venture upon an enquiry after the object which they had seen falling at some distance from their habitations. But when the stone was found, the inhabitants eager to turn it to some profit, broke it up into small pieces. It was known only that a portion of it examined by the hydrostatic balance gave a spec. grav. of 2.80 and that it had no action on the magnet.

Rev. Enc.

6. *Remarkable Diamond*.—The East India Company have sent to England a Diamond which was taken from the Pacharva of the Mahrattas, which weighs 358 grains. Next to the regent diamond, and one belonging to the Emperor of Russia, it is the finest stone in Europe. *Rev. Enc.*

7. *Circulating Libraries*.—According to a published account there are in England about 600 reading companies or associations, (consisting of from 10 to 25 or more members) which procure for their own special use such publications as they may wish to peruse, and at certain periods those books which have been the round among the members, are at a general meeting of the company sold to the highest bidder. The funds are thus replenished, and knowledge and entertainment of the best kind agreeably, and cheaply provided.

8. *Traveller's Society*.—A social company has been formed in Liverpool under the name of the *traveller's society*. No person is eligible to membership who has not been 500 miles from home. At their meetings, it will readily be imagined there must be a variety of amusing and instructive anecdotes, and much information imparted that will naturally tend to enlighten and liberalize the mind.

9. *Russian Establishments*.—Count Romanzof (the same person that charged himself with the expense of the expedition of M. de Kotzebue) who is possessed of an immense estate in the government of Mechilof, with a view of providing for the education of the children of the peasantry, has erected a beautiful building for a school and dwellings for masters. It is destined to receive three or four hundred pupils, who will be instructed in reading, writing, calculation, geography and some knowledge of natural history. They may also acquire the elements of useful trades. The name of Romanzof is one that cannot be pronounced without mentioning some new act of beneficence. *Rev. Enc.*

10. *Lunar Volcanos*.—Dr. Olbers observed on the 5th of last February, the phenomenon which some philosophers have attributed to volcanos in the moon. He declared that he never perceived it more distinctly. The spot called Aristarchus, threw out a very vivid light, and appeared like a star of the 6th magnitude, placed on the north-east of the moon. The evening of the 6th unhappily was not so fine as that of the preceding day, and Dr. O. could not pursue his observations, but the English journals announce that Capt. Kater had made on the 7th of Feb. a report to the Royal Society of London in which he affirms that he had seen a lunar Volcano in actual eruption. Dr. Olbers thinks that the observations of Capt. K. coincide exactly with his own, but he differs from him with respect to the cause. He does not admit the existence of a volcano in the moon; he thinks that the phenomenon which Capt. K. regards as such, is produced by the reflection of the light cast by the earth on the open immense rocks of a smooth surface, situated on the part of the moon called *Aristarchus*. Should these rocks, says Dr. O. send back only a tenth part of the light which they receive from the earth, (our mirrors return one half of the incident light) the effect would be equal to a star of the sixth magnitude. It is in this way that Dr. Olbers accounts for our always seeing those spots in the same place, and also why they do not show themselves at each lunation. On the 6th of March, Dr. Olbers could distinctly see all the spots of the moon; Grimaldi, Copernicus, Kepler, Manidius, &c. Aristarchus, was particularly remarkable, but it was not so splendid as on the 5th of February.

The hypothesis of volcanoes in the moon is not modern, and at present it is almost rejected, and the explanation of Dr. Olbers is generally admitted. The spot *Aristarchus*, is plainly to be seen when the moon is illuminated by the sun, and hence it is natural that it should appear more luminous than the rest of the disc, when it is enlightened only by the earth. As to the variation of extent which is remarked commonly in the spots at the beginning of a lunation, the phenomena of refraction, produced by the position of the moon near the horizon, are sufficient to explain it without having recourse to Lunar Volcanoes. *Rev. Enc.*

11. *Pavia.—Remedy against Hydrophobia.*—New experiments, prove the efficacy of chlorine in the treatment of Hydrophobia. Dr. Previsali has prescribed it with success, in several cases in which the symptoms of that frightful malady had already manifested themselves. He administers it in the form of a drink in the dose of a gros or a gros and a half per day, in citron water, or citron syrup. *Rev. Enc.*

12. *Padua.*—The enterprising traveller Belzoni having given to Padua his native place two colossal statues of Isis, of Egyptian porphyry, found in the ruins of Thebes, the grateful Paduans in placing them in the Sola dello Ragione had a large medal struck in honour of their fellow-citizen, representing on one side the two Egyptian statues, and on the other, bearing an inscription. *Idem.*

13. *Libraries of St. Petersburg.*—1st. the *Imperial Library* at the hermitage, contains 300,000 volumes. Though already rich in beautiful and rare works, it continues to increase in them. Two Librarians are charged with the care of it. 2d. The *Library of Zukuski*, now *imperial*. It belonged to the republic of Poland, and was transported in 1799 to Petersburg, where it has been carefully placed in an elegant building. At each stage there is a beautiful rotundo, and two lateral halls. It contains like that at the hermitage, 300,000 volumes, among which, are the most valued works of ancient and oriental philosophy. It is preserved with care, and open to the public. 3d. The *Library of the Grand Duke Constantine*, consisting of about 30,000 volumes of diplomacy, history, and the military art.

4th. *That of the Academy of Sciences*: next to the imperial Libraries, this is the most considerable, for it contains 60,000 volumes: among which are 3,000 in Chinese, Mantschou and Tongtutschou. It is rich also in Asiatic manuscripts, in drawings of plants and butterflies, and in other objects of natural history, coming from Madame Mérian and Dr. Fothergill. The Russian works to the number of 3,000 are separate from the others. 5th. *The Library of the Convent of Newski* containing Slavonic manuscripts, acts of councils, writings of the German philosopher Wolf, and many theological treatises. 6th. *The Library of the corps of Imperial Cadets*: it has more than 12,000 volumes, and is annually increasing. 7th. *The Library of the College of Medicine*. 8th. *That of the Economical Society*. 9th. *That of the University*, lately founded and which has already 11,000 volumes.

St. Petersburg contains besides more than twenty private libraries, worthy of being mentioned as well for their extent as for the rare and valuable works which they contain; such are those of Counts Ischernichef, Schouvalof, Ischeremetef, Strogonof, Youssoupof, Boutourlin, the late princess Datschkof, counsellor Betzkoi, of prince Kourakin, of Lieutenant General Klinger; the latter possesses the best collection of literary, historical, philosophical and political works in English, French, German and Italian. It contains a beautiful collection of autographic manuscripts of princes, officers, statesmen and learned men of the different countries of Europe. This collection known at first under the name of Doubrowski, is become imperial.

Rev. Enc.

14. *Aurora Borealis*.—*A Royal Author*.—The Ex-King of Sweden (Colonel Gustavson) has printed at Frankfort, a memoir entitled, “Reflections on the phenomena of the Aurora Borealis and its relation to the diurnal motion.” It is written in French, and dedicated to the Royal Academy of Sciences of Norway. The Aurora Borealis has been ascribed to various causes,—by Mairan to the solar atmosphere,—by Lemonier to a matter which exhales from our globe, and arises to a prodigious height in the atmosphere, by Dr. Franklin and others, to electricity—by Dalton and Arrago to an effect purely magnetic—this last opinion has been generally adopted. Colonel Gustavson endeavours

to prove that the Aurora Borealis has its origin in an inflammable matter produced by the friction of the globe in turning upon its axis, and by an electric fire, which collects round the pole. He figures to himself this region as a great mountain, rising in form of a cone at the foot of which are attached petrified flakes of ice which plough the icy sea. He supposes the terrestrial atmosphere to be vastly higher than is generally admitted, and that the polar mountain is a magnetic mass of an immense volume, the effect of which is to maintain the diurnal motion of the earth!!

Rev. Enc.

15. *Geneva.*—The method of mutual instruction continues to receive direct encouragement in our city. A very large building is now constructing, in which is to be placed a new public school, organized according to this method. Many of our protestant pastors of the country have established similar ones in their parishes, and direct them themselves with a zeal worthy of the greatest praise. Their example has been imitated by several rich proprietors, notwithstanding the opposition both open and disguised of certain curates.

Idem.

16. *Naples—Surgery.*—Catanoso of Messina, a pupil of the medical school of Paris, has performed thirteen times in succession in this city, and with the happiest success, the operation for cataract by extraction.

17. *Deaths in France.*—Gouan, the oldest of the professors of the school of Montpellier, the friend of Linneus, of Haller, of Seguiet, of Jussieu, and other celebrated botanists. He died at the age of 88.

Corvisart, one of the most distinguished physicians of Europe, died at Paris at the age of 67, on the 19th of September last. He was first physician to Napoleon. His obsequies were celebrated at Athens where he had an estate. Leroux Dean of the faculty of Medicine, pronounced on the occasion a discourse in which he expressed the regret of all those who knew this celebrated man, to whom the medical sciences were under so many obligations.

18. *Ellious Boethor*, professor of Arabic in the King's Library. He died of a disease of the liver after two weeks illness, on the 26th of September. He was born at Syout, in Upper Egypt, and was interpreter to the French army. He was scarcely 40 years of age. He had acquired by labour and study, great perfection in the language and literature of France. He expressed himself with facility and clearness in French and in Arabic, and though it was easy to recognise in his delivery a foreign pronunciation, it was not so with respect to the propriety of his terms and even the elegance of his diction.

The loss of this man is to be regretted not only on account of oriental literature, and public instruction: it is still more sad in reference to the civilization of Egypt. He formed a natural tie between France and his native country. Familiar with the grammarians, the literati, the philosophers, and all the principal writers of France, he would have been able, above every other person, to initiate pupils chosen among his own countrymen in our arts and sciences.

Ellious Boethor first became known at Paris, a few years since, by his decyphering and translating with the greatest facility, the numerous pieces in Arabic preserved in the war department. He brought with him a large dictionary in the two languages, the fruit of ten years labour and meditation in which each of the acceptations of the Arabic words is justified by examples taken from good authors. This manuscript is in the hands of his widow, and constitutes her whole dependence. We doubt not that the government will obtain it and print it for the benefit of students, and especially of the pupils in the oriental schools of Paris and Marseilles. We believe the author had also composed an Arabic and French Grammar. He has left a blank very difficult to fill, for it requires conditions which it is almost impossible to conciliate.

Jomard. Rev. Ency.

19. *Botany*.—They are now cultivating in Sweden the *astragalus balticus* (Linneus) as an excellent substitute for coffee, and the decoction of which requires only the fifth part of the sugar commonly used. This plant produces six hundred or a thousand fold, and does not suffer from intense frost. Dr. Bayrhammer of Wurtzburg, offers to

send gratuitously one hundred grains to any one who will promise to cultivate it, and make known the result.

20. *Style of the Orientals.*—A diploma of the Persian order of the *Lion-of-the-Sun*, which has recently been sent to Joseph de Hammer, of Vienna, presents in the following address, literally translated, a curious example of the oriental style. It thus announces the titles that have been given him on this occasion:—"Very estimable, very honourable, eloquent in the art of oratory penetrating, skilful interpreter of the language of the good christian people, who believe in Jesus, Counsellor of the high imperial German Court, whose pen is well made, whose writing is flowery, whose fingers are nimble, whose tongue is well practised, column of the most excellent and the most venerated, lily of ten languages, Joseph Hammer, &c."

21. *The Inauguration of a Colossal Statue of Luther*, was to take place in the city of Wittemberg, by order of the Prussian Governments, and with great solemnity, on the 31st of October, the anniversary of the day on which Luther separated from the Catholics, by posting upon the University of Wittemberg, in 1517, his famous Theses against the Court of Rome. The king, and all the protestant princes of Germany were to assist at this ceremony, which is a national festival to the whole of evangelical Germany.

Rev. Ency.

22. *Amsterdam Canal.*—The Dutch are actively engaged in constructing a grand Canal in North-Holland. It will be twelve miles in length, and twenty-five feet deep, so as to be navigable for East-India ships from the Helder and the large port of Het Nieuw Diep, to the Het Y. before Amsterdam. This undertaking does great honour to the inspector general Blanken: it is no inconsiderable enterprise to construct a canal of this extent in a marshy soil, consisting in a great measure of a kind of floating turf under a bed of clay, and of attaching to it massive sluices, each of which must cost 300,000 florins. A great number of boats must be employed in carrying away the turf and mud taken from the canal, for it will not do to throw upon

the borders of the canal such a mass of soft materials, as it would soon sink back again by its own weight. The labour will cost many millions; the commerce of Amsterdam, to which this canal must be of the greatest importance, will contribute a million of florins of Holland. A part of it is finished, as well as the first great sluice at the entrance of the canal, opposite to Amsterdam.

23. *Cutlery.—Damascus Steel.*—One of our most skilful and industrious cutlers, Sir Henry de Besançon, having acquired the art of fabricating the steel, called *Damascus*, very superior to that of Persia and Syria, now employs it in making instruments of surgery, which are far more valuable than those of English cast steel. The extreme hardness, and great elasticity of the *Damascus*, render it particularly important in the fabrication of instruments that require a very fine edge, such as razors, bistouries, lancets, instruments for cataract, &c. which so soon lose their edge, especially when used to pierce or cut very strongly resisting bodies. We have seen the lancets of Sir Henry pass through with the greatest facility pieces of parchment and thin plates of lead, without any injury to the edge, whilst very good common lancets, treated in the same manner, were either broken, or so much dulled as to be unfit for use. Sir Henry fabricates with his *Damascus* all other kinds of cutlery, as knives, scissors, &c. with which bones, ivory, and even iron may be cut, without being dulled. The “Society of Encouragement,” the *New Journal of Medicine*, and many other *Gazettes*, have spoken with much eulogium of these new and useful products of French industry. Sir Henry has his in the *place de l’école de Médecine*,” at Paris.

Rev. Ency.

24. *Instruction in Latin by the method of J. J. Ordinaire.*—In stating that several institutions in Paris have adopted the method of instruction devised by J. J. Ordinaire, Rector of the Academy of Besançon, we engaged to make known their labours and success. We attended the exercises which took place on Tuesday the 19th of July, in the beautiful establishment of M. Morin, the only one which M. Ordinaire superintends himself. The following are the results which appeared at that time. The class of M. Mo-

rin was opened in the beginning of June. In the course of the first week, four divisions, composed of seven or eight boys, were successively formed and exercised upon the new system. The first division, that is to say, the most advanced pupils, had been engaged only six weeks, from which must be deducted Sundays and holidays, which reduces the time to thirty-five days, during which they were engaged in study. In this short space of time the pupils of the first division, who before knew not a word of Latin, had learned, 1st. the twenty-six tables of Latin declinations, regular and irregular, so as to repeat, without the least confusion, any of the cases, separately or collectively, and in any order which might be pointed out. 2d. The signification of a thousand Latin substantives, namely, all those which are found in the text of *Epitome historiae sacrae*. They give not only the French which agrees with these words, but also the Latin when the French is named to them, and likewise the proper inflections of three thousand Latin radicals in either of the numbers named to them. 3d. These children knew in the same manner more than 200 Latin adjectives, to which they could give the substantive termination and declension, when the adjective was derived from a substantive, or the *adverbial* termination, when they were susceptible of it.

¹⁸⁴ The pupils of the other divisions followed very closely those of the one we have just spoken of. All replied with facility to the questions put to them upon the radicals and declensions, upon the formations of cases, genders and numbers; on the value of the Latin accent, the orthography of the two languages, &c.

¹⁸⁵ We remarked also among these pupils that emulation and satisfaction which the old method regards as incompatible with the study of the dead languages. The ardor of these children is such, that they are obliged to moderate it, and there is no question that after four months' application they will be able to explain the *Epitome historiae sacrae*—a result to which M. Ordinaire himself had allotted at least eight months.

There is no father of a family, no member of the university, who attended these exercises, that did not unite his thanks to those of the "*Society for Elementary Instruction*," at its last session, to the respectable Rector of Besançon.

Rev. Ency. for July, 1821.

This new method of teaching Latin, depending in some measure on a new tabular arrangement, or classification of words which the pupils are to commit to memory, has excited considerable attention in France. It is thus noticed in the *Revue Encyclopedique* for September last :

“ We have shewn (page 230) the point to which the pupils of M. Morin, instructed by this method, under the direction of M. Ordinaire, had attained on the 19th of July last, after thirty-five days of study. From that time to the 24th of September, in spite of the derangements caused by vacation, the more advanced pupils have learned more than 1,800 words, viz. the rest of the adjectives in the *epitome historiae sacrae* with their adverbial inflections. 2d. The table of the names of Latin numbers, ordinary and cardinal, as well as the adjectives and adverbs derived from them. This table is so familiar to the children that they translate immediately, and without hesitation, the most complicated numbers expressed either in Latin or in French,—a thing which no pupil of Rhetoric, and even very few professors, would be able to accomplish. 3d. All the pronouns. 4th. The prepositions, with their complements. 5th. The verbs, regular, irregular, and deponent of the first and second conjugations. These 1,300 words, added to the 1,200, which the pupils knew in July, form a total of 2,500 Latin radicals, to which they apply all the inflexions of each of them. Furthermore, they translate immediately, with the greatest facility, Latin phrases formed of those words, the explanation of which requires no knowledge of the rules of Syntax ; and they analyze them also with perfect regularity. But what is still more remarkable, they turn French phrases into Latin, without any other assistance than their memory and their judgment, which are equally developed by these exercises.

Such are the results which M. Ordinaire has obtained in three months and a half, with pupils frequently interrupted in their studies ; results which any one may verify for himself, as we have done, with the deepest interest.

The increasing success of this Latin class has determined M. Morin to annex to his establishment a contiguous building, which will give him the means of receiving seventy additional boarders. Experience has proved that the more considerable the number of pupils, the more rapid is their progress, because then it is more easy to class the children

according to their attainments. A professor has been sent from Brussels to acquire this method of instruction, in order to introduce it into the capital of Belgium. Let us hope that the university of France will not allow foreigners to take the lead in this system, but that it will promptly introduce it into the inferior classes of the Royal Colleges. This hope is the better founded, as the members of the corps of instruction, who have studied the work, or attended the school of the Rector of Besançon, found nothing to object to the method, and accorded with all those who have reflected on the subject, as regarding this system as infinitely superior to the existing method, the great defects of which occasion so much daily trouble to parents and the friends of youth.

25. *Physiology*.—Dr. Magendie, of Paris, has commenced the publication of a Quarterly Journal, entitled "*Journal de Physiologie experimentale*." The first three numbers have reached us, in which we find several interesting memoirs from the pen of that ingenious and indefatigable physiologist. In a short memoir on the structure of the Lungs in men, contained in the first number, the following facts are stated: 1st. That the greater part of the organic tissues contain so great a number of blood vessels, that they appear to be entirely formed of them. We may consider this fact as the actual limit of the anatomy of structure. 2d. That the best mode of studying the structure of the pulmonary organ is to inflate it partially by the orifice of one of the bronchial tubes, place a ligature so as to prevent the escape of the air, and then to let it dry in the open air, or before a fire. It is then transparent, and may easily be cut by a sharp instrument into thin slices. 3d. If one of them be held between the eye and a light, the pulmonary cells may be easily distinguished. These cells assume no regular form, appear to have no membranous parietes, but to consist entirely of the ultimate divisions of the pulmonary artery, the radicles of the pulmonary veins and of the multiplied anastomoses of all these vessels. 4th. That the cells of the lungs increase in size and diminish in number, as life advances. 5th. The specific gravity of the lungs is accordingly so diminished by age, that the lungs of an old man weighed fourteen times less than an equal vol-

ume of the lungs of a child. 6th. This increase of the cells is so regular, that in general the age of the individual may be assigned very nearly by inspection of the lungs. Disease, however, modifies the dimensions of the cells. Those who have coughed much before death, have them generally larger. 7th. If in individuals of advanced age, we find one side of the lungs diseased, the healthy lobe, inflated and dried, resembles a light foam. 8th. Old people accordingly consume less oxygen, have less animal heat, and are less able to resist cold than the young. 9th. The first indications of Phthisis of the most common or tuberculous kind consists in the deposition a greyish yellow matter in one or more of the cells of the lungs. This matter is sometimes moveable, and may probably be expelled, but it frequently increases, adheres to the small vessels, gradually obliterates them, and the whole lobe becomes tuberculous, or formed of this greyish yellow matter. 10th. Numerous as have been the bodies of Phthisical patients, which Dr. Magendie has opened, he has never seen in the cells, those little pearly grains, which, according to certain authors, are the first germs of Phthisis, but on the contrary, the matter which first forms is that which has been named tuberculous, and this matter has the appearance of being a secretion by the parieties of the small pulmonary blood vessels. 11th. Admitting this to be true, the commencement of Phthisis is only an alteration in the habitual secretion of the vascular tissue of the lungs, and this is one of the reasons which induced the author to employ sedatives, and particularly the hydro-cyanic-acid in the treatment of the two first stages of Phthisis. He has ever since had occasion to congratulate himself on this practice.

26. *New method of taking a fac-simile*, by Cadet de Gassicourt.—Paste a piece of white paper on the inside bottom of a porcelain plate;—write upon this paper with common ink, and before it is dry, sprinkle upon it very fine powder of gum-arabic, which will form a slight relief. When the ink is dry, brush off very lightly the superfluous powder, and pour into the plate a melted compound of eight parts of Bismuth, seven of lead, and three of tin, which is fusible at the boiling temperature. Cool it rapidly to prevent crystallization. A counter impression of the writing is thus ob-

tained, and by dissolving off the gum in tepid water, the plate presents characters, which, viewed by a lens, are very legible and beautiful. From this plate, by means of common printing ink, true fac-similies of the original writing may be produced.

Writing already dry, may be copied in the same way by going over the letters with a pen dipped in a very weak solution of gum, and then sprinkling it with powder, and proceeding as before, the only requisite precaution in this metallo-graphic operation, is, that the metallic plate must be of an even thickness, and that the surface on which the characters are traced must be smooth.

An. l'industrie national.

27. Mineral Waters.—A memoir of Professor J. Anglada of Montpellier, relative to the disengagement of azotic gas from sulphurous mineral waters, published in the *Annals de Chimie* of October last, exhibits the following results:—

1st. Those mineral waters, which, by the uniformity of their volumes, at all seasons of the year, seem to depend least upon the variations of the atmosphere, imbibe nevertheless a portion of atmospheric air, which is probably renewed by currents, the origin of which is unknown.

2d. The oxygen of the air, which accompanies sulphurous waters, combines with their sulphurous principles, while the azote escapes in a state of purity.

This disengagement of azote, and the presence of a glai-rous matter, analogous to animal substance, are good indications of degenerated sulphurous waters.

4th. This reaction of the air upon the sulphurous principle of mineral waters, is effected at all temperatures.

5th. If the characteristic phenomenon of this reaction (the disengagement of azote) cannot be asserted with respect to all sulphurous waters, (which requires more exact observations upon all the varieties of water) it is at least acknowledged that it holds good in all sulphurous waters, that contain an alkaline hydro-sulphate, (sulphuret?)

6th. The determination of this cause, destructive of the characteristic principle of sulphurous waters will often lead to the adoption of means proper to render this decomposition less active, and consequently to give a certain fixity to the dominant virtues of these waters.

7th. The influence of atmospheric air, which thus manifests itself, by the disengagement of azote, and the destruction of the sulphurous compound, is reproduced upon acidulous waters with the disengagement of azote, and according to all appearances, with the formation of carbonic acid.

28. *Incombustible cloth.*—Gay Lussac has ascertained that the hydrocholate (muriate) sulphate, phosphate, and borate of ammonia, borax, and some mixtures of these salts, are the most proper substances for rendering linen, or cotton cloth incombustible without changing their qualities.

29. *Cobalt.*—Dobereiner has contrived the following method to separate cobalt from nickel, and other metals from their oxids.

The oxide of cobalt or of nickel is mixed with oxalic acid, and exposed in a retort to the heat of a spirit lamp. When no more vapours are disengaged, or when the metal has acquired an ash-grey colour, the heat is withdrawn, and there is found in the bottom of the retort a pulverulent precipitate, which is the pure metal. This precipitate is introduced into a glass tube, and when subjected to a slight fusion, a button of pure metal is speedily formed.

Bul. de la Soc. D'Encouragement.

30. *Pyrolignous acid.*—There can be little doubt that the ordinary practice of curing meat by smoking, depends upon the action of pyrolignous acid, disengaged by the slow, and imperfect combustion of the fuel. It has accordingly been found that meat may be preserved, after it has been salted, by dipping it into an aqueous infusion of the soot of wood. A pound of soot is sufficient to cure three pounds of beef. The soot is put into a vessel with four pints of water, and allowed to macerate during 24 hours, with frequent stirring. It is then decanted, and it is found to be charged with about $\frac{1}{3}$ of its weight of the acid, and bituminous principles of the soot. In this solution the meat remains half an hour. It is then taken out and dried in the open air, and may be preserved at pleasure.

Bul. D'Encour. August 1821.

31. *Signals for a great distance.*—Schumacher, a captain of artillery, has invented a Rocket which may become of great use to astronomers, and geographers. They have a much greater force than the Congreve rockets, and ascend to a prodigious height. When at their greatest elevation they explode, and produce in the air a volume of light, so strong, and clear as to be distinctly perceived at a distance of 30 leagues. The inventor placed himself in the little Island of Hveen, in the Cattegat, and launched his rockets; while his brother posted himself at the observatory of Copenhagen, to notice the effect. Though the distance is nearly 30 leagues, he saw, by means of a telescope, the explosions appear and disappear, resembling stars of the first magnitude. It is impossible to imagine signals more beautiful, or more expeditious for great distances. *Idem.*

32. *Merino sheep, and wool.*—A number of Merino sheep, and a quantity of wool, were sold at the Rural, and Royal establishment of Rambouillet, near Paris, on the 8th and 9th of June last.

The wool sold for 4 francs $\frac{57}{100}$, the kilogramme in the dirt. Lamb's wool, for 3frs. $\frac{27}{100}$, the kilogramme, (2lb. 3oz. 5dr. English)

Seventy rams, and sixty-four other sheep were sold, covered with wool. The highest priced ram brought 3117 $\frac{1}{2}$ francs, and the lowest price 376 $\frac{1}{4}$ frs.

The maximum price for the other sheep, 258 francs, and minimum price, 134 $\frac{3}{8}$ francs. *Au. de Chinuc.*

33. *Enamel for porcelain.*—The society at the Adelphi for the encouragement of the arts, have acknowledged the superiority of an enamel, or glazing, for fine porcelain, composed by John Rose. It consists of a mixture of 27 parts of feldspar, 18 of borax, 4 of sand, 1 of common salt, 1 of nitre, and 1 of argil. After it is melted into a frit, three parts of borax are to be added, and it is then reduced to powder.—This enamel attaches itself easily, and uniformly, without melting or even softening of the porcelain. It diffuses itself uniformly, without lumps or unevenness, and it does not conceal, or change the most delicate colours, such as greens and chromic red.

34. *Magnetism*.—Professor Hansteen, of Christiana, has announced the discovery, that all vertical objects, such as a tree, a wall, a steeple, &c. naturally becomes magnetic; the inferior parts acquiring a north, and the superior a south polarity. We shall wait impatiently for the particulars of these experiments. This subject has acquired a most lively interest in the estimation of philosophers, since Mr. Oersted has shown the relation between the magnetic, and electric fluids.

Rev. Ency.

35. *Orangeries*.—The inhabitants of the maritime Alps derive important profits from the cultivation of the orange. The town of Menton is the most famous for this fruit. It is gathered during the whole year. A good orange tree yields annually 2000 oranges, large and small, and occasionally the produce amounts to double that quantity. Those destined for commerce are gathered in winter, just as they begin to ripen, and become matured during the voyage.—Every orange must be wrapped in a separate paper envelope. The gathering, and packing occupies many hundred people. Considerable profit is also derived from the orange flowers. A singular fact is, that the orange tree communicates a bitter taste to the herbs that are cultivated around it. The citron has not this disadvantage.

Rev. Ency.

36. *Agriculture*.—Count Lasteyrie, of Paris, who has distinguished himself by his generous efforts in introducing, and perfecting the process of lithographic printing in that metropolis, has just completed the second, and last volume of a pictorial representation, and a verbal description of the machines, instruments, utensils, constructions, apparatus, &c. employed in rural, and domestic economy, according to designs made in different parts of Europe. The work is in quarto, and contains more than 1200 machines. The plates are executed without great attention to elegance, but with requisite precision, and exactness.

37. *Measurement of the meridian*.—Operations relative to a new measurement of the meridian, were commenced during the last summer, in the Russian provinces of the Baltic. Struve, professor of astronomy, and rector of the

university of Dorpat, presented the plan of this enterprise, which began upon the meridian of the observatory of Dorpat, Lat. 56 N. It will be executed at the expense of the university. The emperor has approved the plan, and has given two thousand ducats to procure the requisite instruments. Dr. Walbeck, astronomer at the observatory of Abo, acts in concert with professor Struve.

38. *Gymnastics*.—The Gymnastic establishment of M. Cliaș, in Switzerland, which has existed seven years, has obtained complete success. There now exist in the different cantons, fifteen gymnastic schools, well organized, annexed to academies, or colleges, and directed by pupils of M. Cliaș. A great number of boarding schools have also adopted gymnastic exercises, because they begin to feel generally, the advantages of this part of education.

39. *Marseilles*.—*Mutual Instruction*.—An evening school has just been opened in this town, for the admission of a great number of adult workmen. The minister of the interior, with a view to encourage this philanthropic object, has granted assistance to the founders of this school. In many establishments, the evening hours of the society are devoted to the elementary instruction of adults. The friends of humanity will doubtless wish, that these examples may find imitations in all parts of the kingdom.

40. *Zeal for antiquity*.—The circular zodiac of the temple of Denderah, in Upper Egypt, one of the most celebrated, and ancient pieces of antiquity, in relation to astronomy which the world can produce, has, with astonishing address, and dexterity, been removed from the elevated platform of the temple, conveyed to the Nile, floated down the rivers to Alexandria, and transported to Marseilles, whence it will be taken to Paris, to ornament probably, the grand museum of the Louvre. It is a stone of about 10 feet square, attached to a mass of rock $2\frac{1}{2}$ feet thick.

41. *Hospitals in France*.—It appears by a recent work of Baron Dupin, entitled "*Histoire de l'administration des secours publiques*," that the number of individuals in the hospitals, and alms-houses of France, is now about 90,000,

viz, 30,000 sick—35,000 aged and infirm—and 25,000 children. In this number is not comprised, the aged who are supported at home, and the children at nurse in the country. The expense of this vast charity is estimated at 90 centimes, ($\frac{9}{10}$ of a pound) per day, for the sick; and 60 centimes for the aged, and for children: hence the total is from 24 to 25 millions (from 4 to 5 millions of dollars.)—The revenue of these establishments exceeds this expenditure, and is daily increasing by numerous legacies. Before the revolution, the number of foundlings supported by the public was about 45,000. It is now 60,000, and the expense of their maintenance is seven millions. Before the public bounty was extended to this numerous class of innocent sufferers, children abandoned by their parents, were publicly sold, under the portals of the church of St. Landry, to women with full breasts, to boatmen, to beggars, and it is said, to magicians. The current price was 20 sous.

42. *Animal Magnetism*.—It appears from the French Journals, that this singular and incomprehensible doctrine has been revived in Paris; and if a statement of certain effects produced by magnetism, at the hotel Dieu, during the months of October, November, and December, 1820, in presence of seven or eight Physicians, and several other persons whose names are given, are worthy of reliance, it must be acknowledged that the commissioners appointed by Louis XVI, with Dr. Franklin in their number, were clearly mistaken; and that Mesmer ought to be regarded as a man of real genius, misunderstood, and persecuted by his cotemporaries.

A detail of several cases has been signed by thirty physicians, and acknowledged by M. Husson, the hospital physician. One of these cases was, that of a young girl affected with hysteria, and spasmodic vomiting, which nothing could check. She was quite given up, and her end regarded as near. As soon as she was magnetised, the vomiting ceased, and after a few trials she fell into a somnambulism; and experiments the most varied, ingenious, and exact, convinced the doctor that the magnetic influence was real, curative, and entirely independent of the imagination.

In other cases the magnetic sleep became so profound, that neither calling aloud in the patient's ear, shaking, pinching, nor even a caustic applied to the upper part of the thigh, and to the epigastrium was able to produce the least sign of sensibility either by cries, motions, or variations of the pulse.

Rev. Ency. Dec. 1821.

43. *Bavaria.—Mineralogy.*—Baron de Schütz, known by the distinguished manner with which, during fifty years he has directed the administration of mines in that country, has just given to the school of *Landshut* his fine collection of minerals, consisting of 2,318 rare and valuable specimens, among which are a great number of fossils. This estimable philosopher, animated by the love of public good, has joined to this rich present, that of a part of his Library.

Idem.

44. *Vesuvius.*—After the last eruption of Vesuvius, in the plain which surrounds its volcanic cone, were formed six other cones more or less profound. One of them rises nearly sixty feet, and has a perimeter of about 200 feet. A torrent of very fluid and ardent lava crosses it within. It was into the crater of this cone that a young French Officer, Louis Coutrel, precipitated himself on the 11th Jan. 1821, to put an end to a life embittered by "*ennui*." Details of this circumstance were read to the Academy of Naples, by the Secretary M. Monticelli.

Idem.

45. *Necrology.*—M. *Rodrigues* a distinguished astronomer, who was appointed by the Spanish government to unite with Biot and Arago in measuring an arc of the meridian, died suddenly at Madrid, aged about 45. His engagement had induced him to remain a long time at Paris and London.

46. *A New Mineral*, discovered in a depot of friable lig-trite at Kolowerux, near Berlin in Bohemia, has been named *Humboldtine*, by M. Riviero, who has written a memoir upon it, approved by Vanquelin, and the Academy. It is a *sub-oxalate of the peroxide of iron*.

47. *Society of christian morals.*—This society, quite new in France, held its first general sitting on the 20th of December last, in the room of the society for the encouragement of national industry. The Duke de la Rochefoucault Liancourt, peer of France, presided and pronounced a discourse in which he explored with a mild and persuasive eloquence, the objects and plan of the society. A report was afterwards read by M. Wilm, one of the Secretaries relative to the origin and progress of the association. Its formation has been much encouraged by the example of the *Peace Societies* of England, but the society of christian morals is founded on a more extended plan. No moral scheme, no philanthropic institution will be foreign from its objects. We doubt not that almost all persons in France and even in Europe, who connect in their own minds, sound political opinions with a proper idea of the influence of moral and christian virtue, will be anxious to unite with the new society.

The meeting was composed of distinguished characters. We remarked among them persons of the three christian communions which exist in France, members of both chambers, ecclesiastics, members of the Institute, &c. &c.

The regular meetings, which every subscriber will have the right to attend, will be held the first Monday of every month at 7 in the evening. It is expected that the first number of the journal which the society intend to publish will appear before the end of January, 1822. Letters and subscriptions are received by Treuttel and Wurtz, Rue de Bourbon, p. 17, and by the same house, No. 30, Soho Square, London.

II. DOMESTIC.

1. *Two singular cases of the effects of the nitrous oxid, or exhilarating gas.*

For several years the medical class, and the two senior academical classes in Yale College, while attending the chemical lectures, have been in the habit (each class by itself) of preparing for themselves, and administering to their

respective members, the nitrous oxide, or exhilarating gas.

The relations of the effects of this gas have been so frequent, and similar, that they have become trite ; there were, however, two cases during the last season, which appear worthy of being published.

Case 1.

A. B. a member of the junior class, about 19 years old, is a person of a sanguine temperament, of a cheerful turn of mind, and possessed of the most perfect health. He breathed the gas which was prepared, and administered in the usual dose, and manner. Immediately, his feelings were uncommonly elevated, so that (as he expressed it) he found it "impossible to refrain from dancing and shouting." Indeed, to such a degree was he excited, that he was thrown into a frightful delirium, and his exertions became so violent, that after a while he sunk to the earth, exhausted, and there remained, until having, by quiet, in some degree recovered his strength, he again arose, only to renew the most convulsive muscular efforts, and the most piercing screams and cries, within a few moments, overpowered by the intensity of the paroxysm, he again fell to the ground, apparently senseless, and panting vehemently. The long continuance, and violence of the affection, alarmed his companions, and they ran for professional assistance. They were however, encouraged by the person to whom they applied, to hope that he would come out of his trance without injury, but for the space of two hours these symptoms continued; he was perfectly unconscious of what he was *doing*, and was in every respect, like a maniac; he states however, that *his feelings* vibrated between perfect happiness, and the most consummate misery. In the course of the afternoon, and after the first violent effects had subsided, he was compelled to lie down two or three times, from excessive fatigue, although he was immediately aroused upon any one's entering the room. The effects remained in a degree, for three or four days, accompanied by a hoarseness, which he attributed to the exertion made while under the immediate influence of the gas.

This case should produce a degree of caution, especially in persons of a sanguine temperament, whom, much more

frequently than others, we have seen painfully, and even alarmingly affected.

Case 2.

C. D. a member of the senior class, is a man of mature age, and of a grave and respectable character. For nearly two years previous to his taking the gas, his health had been very delicate, and his mind frequently gloomy and depressed. This was peculiarly the case for a few days immediately preceding that time; and his general state of health was such, that he was obliged, almost entirely, to discontinue his studies; and was about to have recourse to medical assistance. In this state of bodily and mental debility, he inspired about three quarts of the nitrous oxid.—The consequences were, an astonishing invigoration of his whole system, and the most exquisite perception of delight. These were manifested by an uncommon disposition for pleasantry and mirth, and by extraordinary muscular power. The effect of the gas was felt without diminution for at least thirty hours, and in a greater, or less degree, for more than a week.

But the most remarkable effect was that *upon the organs of taste*. Antecedently to taking the gas, he exhibited no peculiar choice in the articles of food, but immediately subsequent to that event, he *manifested a taste for such things only as were sweet*, and for several days *ate nothing but sweet cake*. Indeed, this singular taste was carried to such excess, that he *used sugar and molasses not only upon his bread and butter and lighter food, but upon his meat and vegetables*.—This he continues to do even at the present time, and although nearly eight weeks have elapsed since he inspired the gas, he is still found *pouring molasses over beef, pork, poultry, potatoes, cabbage, or whatever animal or vegetable food is placed before him*.

His health and spirits, since that time, have been uniformly good, and he attributes the restoration of his strength, and mental energy to the influence of the nitrous oxid. He is entirely regular in his mind, and now experiences no uncommon exhilaration, but is habitually cheerful, while before, he was as habitually grave, and even, to a degree, gloomy.

2. *Extracts of a letter from Wm. M^r Clure, Esq. to the editor, dated, Madrid, Dec. 4, 1821.*

Progress of American Science.

"I am glad to hear of the rapid progress science in general, (and mineralogy and geology, in particular) makes in the United States. The men of science in Europe, are astonished at the rapidity with which one discovery succeeds another, and cannot conceive, how, in so short a time, so many hands, and heads are occupied with the exact sciences, and mechanics.

"The vast advantages attached to freedom, are unknown on this side of the Atlantic, and the spirit of energy with which a free people pursue whatever they perceive to be for their interest, are only beginning to be understood by the few.

(From the same, to the same.)

Comparative features of American and European Geology.

"The most striking, and strongly marked difference between the geology of North America, and Europe, is the regularity, continuity, and uninterrupted state of the stratification, for almost the whole length of the continent; and the absence of all rocks of disputed origin.

The trappose hornblendish rock which partially, and in patches, and ridges, covers the old red sandstone from the Connecticut river to the Rappahannock; and where the sandstone has been washed away in the states of New-York, Maryland, and Virginia, loose masses of the trappose rock cover the surface, as evidence of the continuity of the sandstone formation—this hornblendish rock is the nearest to a volcanic formation, of any I have ever seen in the United States, both from structure and relative position; it is found covering puddingstone, and sandstone aggregates, of rounded particles, made so, most probably, by water; while we have not caught nature forming any rocks by water, at all similar to the Hornblendish rock; but we find many volcanic rocks almost similar in structure, and exactly corresponding in relative situation. This gives probability to the supposition, that it is of volcanic origin, and throws

many difficulties, and doubts on the supposition of Neptunian origin, for after the waves on the sea-coast, or the action of running waters had formed the sand, and rolled pebbles; to make the waters return in sufficient quantities to form a rock partly crystalline (which by the Wernerian system would require a great depth) is a forced supposition, that does not appear natural: but such is the forced theory of that system respecting Basalt, and all the newest floets-trap formation, which Werner supposes to be of aqueous origin, while their resemblance, both in structure and relative position, renders the supposition of their volcanic origin, much more simple and natural.

The geology of the United States, where every primitive transition, and secondary rock is found (except the basalt, and the newest floets-trap formation) that is found in Europe; at the same time, that no volcanoes are in action, is a strong argument against the Wernerian system—all these theories have had their day, and are fast going out of fashion."

3. Delaware Chemical and Geological Society.

An Association by this name was organized at Delhi in the month of August. 1821. It is composed of between forty and fifty well informed and respectable inhabitants of the County of Delaware, State of New-York. The object of the association is improvement in literature and science, but more particularly in chemistry, geology, and mineralogy—they proceed with spirit and effect; have collected a cabinet of minerals, and intend to procure a library and chemical laboratory—at each quarterly meeting an original scientific discourse is delivered, essays read, &c.

From the zeal, industry, and talents of the members of the Delaware Society, it promises to be a very useful institution—and we are happy in the opportunity of mentioning it to our readers.

4. Interesting Example of Electrical Attraction.

We have had occasion recently to observe the process of applying gold leaf in gilding the frames of looking-glasses and pictures. It is probably known to many persons, that the frame, after being duly prepared by a composition

which is laid upon it with a brush, is moistened with gin, or some other spirit. The gold leaf, cut up by a round-edged knife into pieces of suitable size, is taken up on a flat hair-brush, and brought with the gold downward very near to the place to which it is to be applied. When it comes within a short distance, generally about half or three-quarters of an inch, without any farther attention from the artist, it suddenly flies from the hair-brush to the surface on which it is to be laid, and clings to it, and embraces it with such delicacy, as to cover every roughness. The gold, apparently, makes just such an effort, as it does when attracted in the gold leaf Electrometer, and it appears to arise from the same cause, viz. an electrical attraction. This attraction is obviously produced by the evaporation of the spirits.

Evaporation is well known to produce electrical excitement, and to generate opposite states of electricity in the contiguous bodies. We should therefore expect the attraction to be strongest in the case of those bodies which evaporate most readily—accordingly the gold leaf is less powerfully attracted when water is substituted for spirit.

The success of the gilder appears, in these cases to depend very much on the exertion of a principle which he is very little aware of. It would seem, that but for this, it would be scarcely possible to apply the leaf with entire precision, to all the varieties of surface produced by the carver. We have thought it worth mentioning, as a happy illustration of a scientific principle, occurring in the practice of the arts.

5. *A Fermenting Pond.*

Extract of a letter to the Editor from Mr. Thomas H. Webb, dated Providence, Oct. 1, 1821.

I lately visited a pond in Sharon, (Mass.) known by the name of Mash-Pog pond, from which great quantities of lenticular argillaceous oxid of iron, and what is called cake ore, are procured. The pond from about the middle of August to some time in September, presents the singular appearance of working or fermenting, as beer does when new. Whether this appearance is peculiar to *this* pond, I do not know.

Remark.—It would be well to catch some of the gases, which, without doubt, cause this intestine motion: most

probably they would prove to be carburetted hydrogen, carbonic acid, &c. the usual products of vegetable putrefaction—but the quantity is certainly extraordinary.—[*Edit.*]

6. *Optical Trap.*

[Communicated.]

To the curious it may not be uninteresting to be informed, that an ingenious sportsman in this vicinity (Newport, R. I.) has lately invented what appears to be an entirely novel mode of trapping birds, animals, &c. This seems to be founded on the principle of the fondness of many animals to associate with each other—and is effected merely by placing a common mirror in a suitable trap, so situated that the animal, in passing to and from its usual haunts, may see itself reflected, and is some how or other curiously impelled to approach the glass, and consequently entrapped—for instance, in order to take minks, muskrats, &c. a common box trap is made use of, with a mirror at the extreme end, (opposite the mouth) this being placed on the margin of a river, or pond of water, frequented by them—they will necessarily see themselves in it, and, like Narcissus, fall in love with their shadows, and are instantly taken. The inventor has not only been successful in taking the above animals, but he assures me that he has recently caught rabbits, and partridges, in one of this construction, and that no less than two dozen mice were taken in one night, without any other bait. W.

Remark.—We believe that this mode is not entirely original, as we have seen the same thing represented in a print, only the game was a tiger.—[*Ed.*]

7. *On the conducting powers of various bodies in relation to radiant matter.*

Extract of a letter to the Editor, from Dr. Hare, dated Philadelphia, May 17, 1822.

“I have found anthracite a tolerably good conductor of the principle evolved by the deflagrator, under those circumstances in which the indications of electricity uncombined with caloric, are very strong, as when the surfaces are subjected to water alone. In these cases it was indifferent

whether anthracite, or charcoal were used ; but when the plates were exposed to diluted acids, there was no ignition so long as the circuit was completed by the former, while by the latter, it must be almost unnecessary to add, the most intense ignition was easily producible. This I ascribe to the high radiant power of charcoal, which I do not believe to arise from any peculiarity in its particles, but from its extreme porosity. When porous bodies are subjected to radiant matter, the latter has access at once to all the particles composing them, but when dense bodies are exposed in the same way, the exterior strata repel the radiant matter, or at most allow it to combine only with their surfaces. The same structure which facilitates the entrance, must of course favour the escape of radiant matter. In consequence of the high conducting power of metals, both as respects heat, and electricity, it were unnecessary that they should radiate in order, for the igneous fluid of galvanism to pass through them ; but carbon being a very bad conductor of heat, is impermeable to that fluid, unless in cases where it contains little caloric, or where containing much of this fluid, circumstances will allow of its separating in rays. Hence, porosity in carbon is requisite to its ignition by the deflagrator. There can be no doubt, that a certain regularity of arrangement, operates like porosity, in favouring the passage of radiant principles. Hence, crystalline masses are often transparent, and glass rapidly receives, or gives out caloric and light."

S

Spontaneous Combustion.

(Communicated by Dr. Samuel Rockwell, of Sharon, Conn.)

" Late in the evening of the 2d of May inst. some of the family of Mr. Charles Elliot, of Sharon, Conn. observed sparks of fire to be blown over the fence of his back yard, from behind his barn, which was attached to a long row of buildings, viz, a hatter's shop, dwelling house, &c. The wind, at that time, being very high, and in a direction to carry the fire directly on to his buildings ; Mr. Elliot and his family were immediately alarmed, and upon examination, found the fire in a heap of horse-dung, which had been flung out of the stable window. The fire on the top of the heap was about two feet in circumference, and there was a bed of coals and embers, for four inches in depth. The

whole heap was excessively hot, and the surface quite dry. The sparks were blown constantly by the wind against the barn, and the rubbish about it. Had it not been for this fortunate discovery, the buildings would very soon have been in flames, and the fire probably beyond control. After a careful examination, by a number of intelligent gentlemen, it was the decided opinion, that the fire originated from a spontaneous fermentation, and combustion of the dung heap. Had the buildings in the present case been burned, or even on fire, the heap would not have been examined or thought of, as the source of the fire, and it would have been believed to have been the work of an incendiary. The question arises, whether some of the instances which in towns, so frequently occur, of fire originating in stables, and which we attribute to incendiaries, may not in this way be accounted for."

9. Geological Survey of North Carolina.

We understand that Professor Olmstead of the University of North Carolina, will soon commence a series of geological and mineralogical observations, intended, eventually, to comprehend a scientific survey of the State. From the known intelligence, zeal and scientific attainments of Professor Olmstead, we cannot doubt, that (*if adequately encouraged by the local government, or by patriotic individuals,*) the enterprize will produce very important advantages to science, agriculture, and other useful arts, and will prove highly honorable to the very respectable State of North Carolina. In no way, in our apprehension, could the same sum of money be more usefully expended, and it would be no small honour to have set the first example of the scientific survey of an entire American State. We hope then to see the next edition of the map of North Carolina present at least the leading features of its geology and mineralogy. It would be very desirable also that the Botany, and if practicable, the zoology of the country should be investigated at the same time.

Voluntary Breathing.

A correspondent suggests, that where the lungs are unusually inactive and breathing very feeble and languid (as occurs both in cases of deep thought and of mental vacuity) respiration, increased both in frequency and degree, by a voluntary effort, gives a quicker circulation to the blood, and an increased activity to the animal spirits. He thinks that in some instances, where he has felt an oppression approaching to pain, in the region of the lungs, he has found himself much relieved by breathing quicker and deeper, and he even conceives that this voluntary effort may become a partial substitute for the respiration of oxygen gas.

11. *Professor Eaton's Geological, and Agricultural survey of Rensselaer County. Dr. J. H. Steel's report of the Geological structure of the county of Saratoga.*

We noticed (page 239, vol. III.) the geological survey of the county of Albany, by Mr. Eaton and Dr. Beck. We have now the pleasure of mentioning the survey of two other contiguous counties. The design reflects much honour upon those enlightened and patriotic persons, who appear as the patrons of the undertaking; and the execution is marked by so much fidelity, and ability, that we think the effect must be to encourage similar attempts. Geological surveys, more or less extensive, have been undertaken with creditable success, in various parts of this country, but we are not aware of any attempt on so extensive, and systematic a scale, to make them subservient to the important interests of agriculture. It was very natural to look for so good, and honorable a precedent in the most powerful state of the national confederacy, distinguished as it is by enlarged views, and great and useful enterprises.

We have neither time, nor space, in concluding the present number, to do any thing more than to recommend the report of Professor Eaton, and of Dr. Steel, to the perusal of all those who are willing to promote some of the best interests of their country, by making science the handmaid to the arts.

12. *Yellow mineral from Sparta, N. Jersey, imbedded in white granular limestone.*

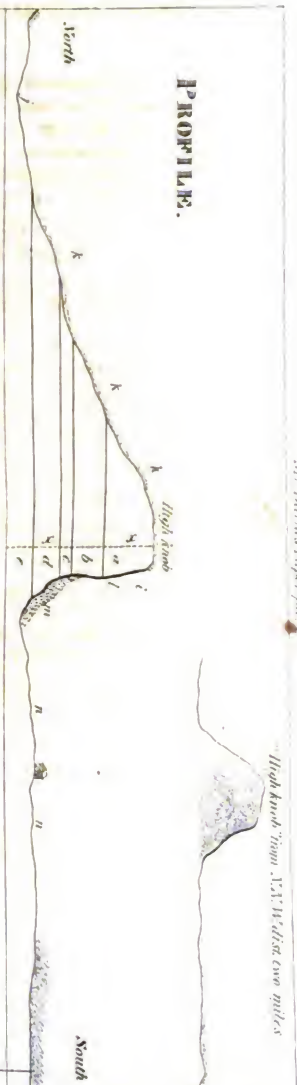
We understand that a detailed analysis of this mineral, which was discovered by the late Dr. Bruce, will soon be published by Mr. Henry Seybert, of Philadelphia, whose experiments prove it to be a *silico-fluate of magnesia*.

We are obliged, for want of room, to postpone an article containing a collection of facts respecting the meteor of March, and some previous meteors.

Explanation of Mr. Barnes' Section of the Canaan Mountain.

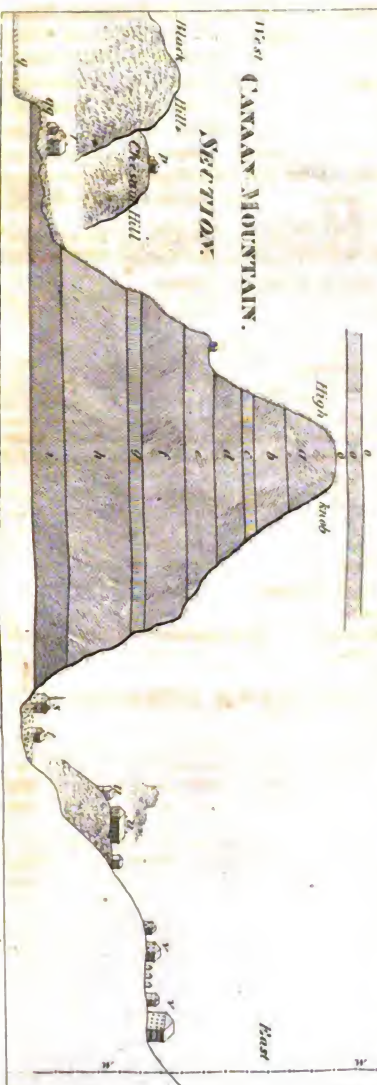
- a. Graywack slate.
- b. Clay slate.
- c. Quartz.
- d. Limestone.
- e. Graywack slate. This rock caps the high hills.
- f. Clay slate. This rock is found on all the adjacent hills of a middling height.
- g. Quartz. This rock is found on low hills, in loose masses.
- h. Limestone. In this stratum are the springs of New-Lebanon, and the lead mine in Canaan.
- i. Roofing slate.
- j. An old field.
- k. k. k. Outline of the top of the mountain.
 - l. l. Inaccessible precipice.
 - m. Fallen fragments of rocks.
 - n. n. Cultivated fields.
- o. o. o. Probable position of a stratum of graywack rubblestone, now disintegrated, and found in loose fragments in the valleys below.
 - p. Samuel Jones', Esq. on Chesnut-Hill.
 - q. Peat bottom.
- q. q. Alluvion.
 - r. Captain N. Jones'.
 - s. N. Lebanon meeting-house.
 - t. E. Tilden, Esq.
- u. u. Pool hill, (limestone.) New Lebanon spring. Hull's boarding house.
- v. v. Shakers' Village.
- w. w. Line of the States of New-York and Massachusetts.
- x. x. Line of section.

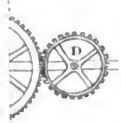
PROFILE.



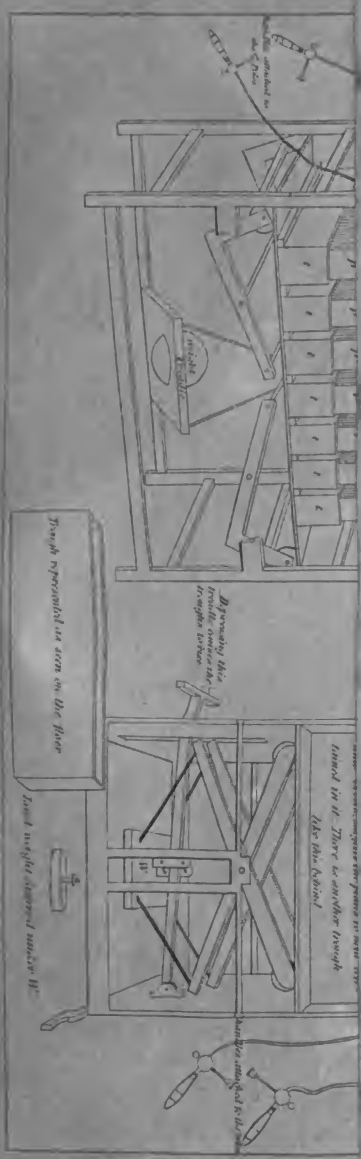
West CANAAN MOUNTAIN.

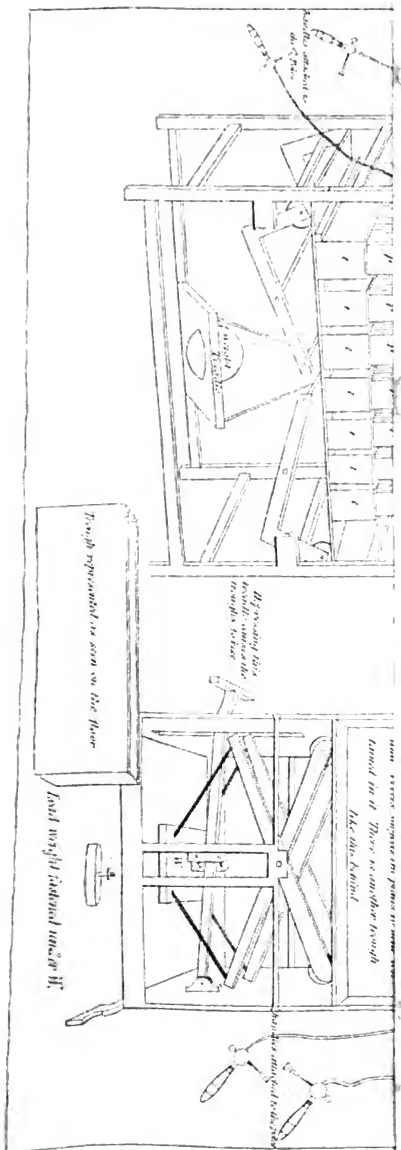
SECTION.





5







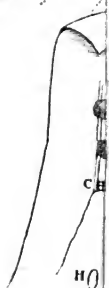
Mr. W's Clothes as for
vid pa 124



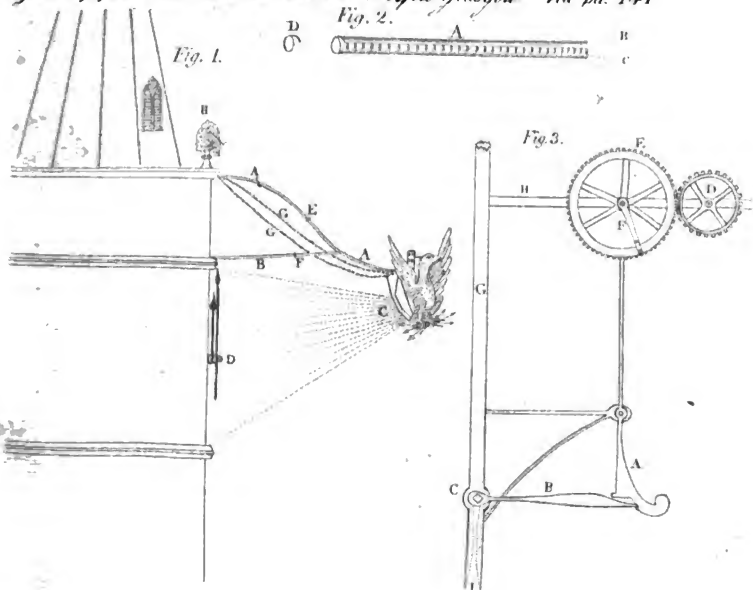
Eight Section of Kensington



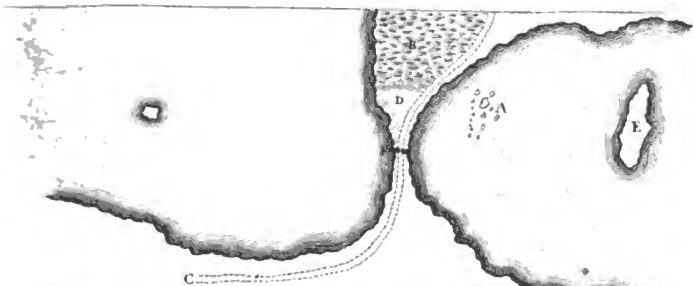
- A Locality of the Sulphate
- B Mill
- C Locality of Coal
- D _____ of Lead
- E _____ of Zoolites
- F _____ of Shale
- G Strata of Sandstone under Trap



Gas apparatus used in the Iron Works Glasgow vid pa. 141



Impression in Sand Stone. vid. pa. 135



View of the junction of N. East & Little Ponds, Salisbury Co. vid pa. 34

EASTMAN'S ROTARY SAWING MACHINE.

3 Saw



7. Hand Frame
Supports hand.

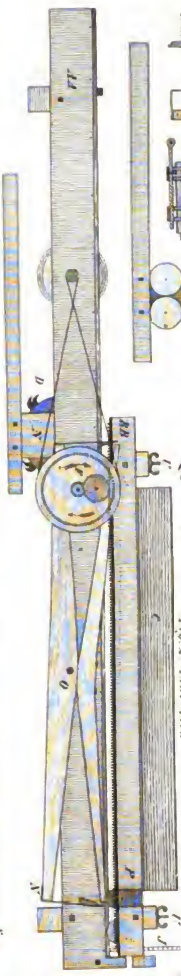
9. Setting iron

6. Snapper

12. Sawdust friction rollers.



Fig. 2. Side view.



11. Trunk.



13. Index.

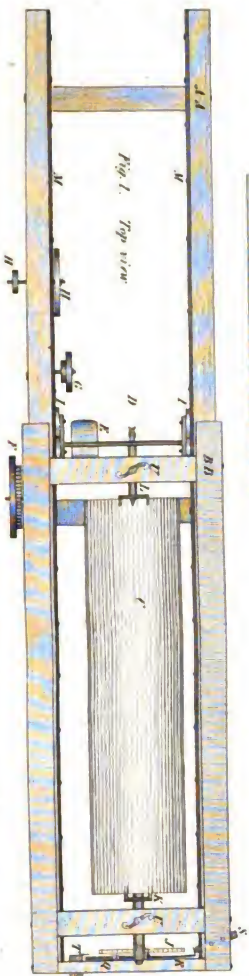


Fig. 1. Top view.

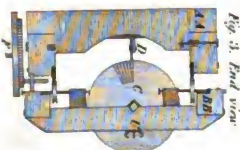


Fig. 3. End view.

Eng^d by Wm. S. S. S. S.



Alfred P. Fox.

E. B. & Co. N. Y.

PROF. ALEX. M. FISHER OF Y. U. C. D. A.

Lost in the ALBION. April 22^d 1822.

THE
AMERICAN
JOURNAL OF SCIENCE, &c.

GEOLOGY, MINERALOGY, TOPOGRAPHY, &c.

ART. I.—*Outline of the Mineralogy, Geology, &c. of Malbay, in Lower Canada, by JOHN S. BIGSBY, M. D. of the British Medical Staff.*

To the Editor of the American Journal of Science.

Dear Sir,

I VERY respectfully beg your acceptance of a sketch of the geology of Malbay in Lower Canada.

In the Summer of 1821 I devoted three weeks to the study of the geology of the highland districts below Quebec, on the north shore of the St. Lawrence, which, in the magnificent forms of their mountains, the beauty of their secluded but populous valleys, and in the affectionate simplicity of their inhabitants, give us a Switzerland in America.

In the present paper the topography, geology, and consequent remarks are placed separately after the manner of Dr. Macculloch, in his account of the Western Islands of Scotland, a work which has given its author unrivalled pre-eminence in geological description and discussion.

I was only five days at Malbay, but they were well employed. I regret that my statements of elevation are but conjecture; being provided only with a hammer, a compass and some sulphuric acid.

The accompanying outline or diagram of Malbay is from the eye, and is intended to impart merely a general idea of the locality. [See the plate at the end.]

Murray or Malbay is a rounded indenture in the north shore of the St. Lawrence, ninety miles below Quebec.

It is a basin, about half a league in diameter, closely invested by a semi-circular range of lofty hills, with irregular and pine-clad summits, and grassy declivities, chequered with the white dwellings of the peasantry. A considerable breach in the middle of this elevated Belt (near which stands the church and a cluster of houses) permits the passage of a noisy river into the St. Lawrence, and discloses in the rear, an ascending country, occasionally distributed into farms ; and supported in the distance by lands of a grand and picturesque outline.

These hills, or mountains, are divided into three distinct portions, occupying respectively the western, middle and eastern sides of the Bay.

The western hill, like the others, is a bluff continuation of the mountain groupes in the interior. Its height is from eight hundred to one thousand feet. The upper parts are broad and protuberant, and are covered with fractured rocks and dense vegetation. At the outer angle of the bay, they dip at once in a dark shattered precipice two hundred feet high, which extends outwards for half a mile (west) a little beyond a thready cascade, and then shelves into a slope of large ruins, either advancing into the St. Lawrence, or resting on low mounds of uninjured gneiss. Inwards, the precipice is replaced by alluvion, clothing the whole declivity which faces the basin, in two or three terraces, frequently broken into knolls, and excavations, or indeed, nearly obliterated by rains and periodical torrents. These irregular deposits preserve nearly the same height ; that of the upper terrace being from three to four hundred feet,—and the lower ones varying from twenty to eighty feet.

Their breadth is small at the outskirts of the bay, but it increases, at the bottom, (from a rough estimate) to seven hundred yards. This latter space is principally taken up by the lowest tier, and presents, among its pasturage and cornfields, a singular and beautiful assemblage of small detached oblong eminences, fringed, and crowned with shrubbery, and greatly resembling the Barrows of the earlier periods of Britain. They are the deposition of conflicting currents of water.

The Middle Hill, from six to eight hundred feet high, is a projecting portion of that on the west, just described, with which it is connected in front by almost perpendicular steeps of sand, clay, and gravel, but grassy, and intersected with deep ravines, filled with coppice, through one of which the Ruisseau de Mayou descends towards the Bay, turning several mills in its course.

As in the former case, the greater part of this hill is buried in alluvion. The upper third is covered with wood, while the imperfect scalar platforms below are apportioned into farms, and furnish sites for dwellings, especially the large and hospitable Seigniorial house of Mrs. Nairne. The eastern face of the hill breaks off almost precipitously to form the defile or river-pass before mentioned, and runs west for six miles as one of the sides of the valley of St. Etienne.

The eastern arm of Malbay is rather shorter than the other, and passes almost insensibly into the general course of the St. Lawrence. It rises along the shore in a waving line from the river-pass, and forming several lofty bluffs, with abraded faces it attains the height of eight hundred feet in a broad summit, mingling to the eastward with the high and rocky country about Cape Eagle. A precipice two hundred feet high, lines the shore for five hundred yards, just at the outside of the Bay, succeeded to the east, by shattered cliffs, slopes of debris, or smooth mounds within the influence of the tides.

The whole space included by these three hills is overflowed only at high water, which then washes the naked banks on the east, passes, (if I recollect aright) a short distance within the breach, and wanders among the marshy indentations of the west side in shallow and winding channels. At ebb, the Malbay River flows sluggishly through the moist sands to join the St. Lawrence at the skirts of the Bay.

The valley of St. Etienne, entered by the defile of its river, ascends northwardly for six miles, and is a straight rugged, and narrow stripe of low land, occupied principally by the ever changing bed of its stream. It is bounded on the west by the Middle Hill; and on the east by the uplands which ascend swiftly into neighbouring mountains, greatly intersected by broken ridges of alluvion, and furrowed by water-

courses joining the river obliquely, and at seasons inundating it with their contents.

About five miles up the valley, a circular expansion of half a league in diameter takes place to the west, from the sudden bending to the north-west of the east face of the Middle Hill. This cavity rises, bowl-shaped, on every side, to the surrounding heights; at first, partially and confusedly, but higher up, in two or three concentric terraces, much injured by natural causes. A streamlet passes through its centre, in a deep woody dell, to join the Malbay river.

On the eastern uplands, about five hundred feet above the present bed of the River Malbay, a flat and uniform embankment extends the whole length of the valley, abraded at intervals by torrents. At a certain distance below this range, another is situated, parallel, and marked with corresponding breaches. It declines rapidly, and is succeeded by the broken ground, and barrow-like tumuli of clay and gravel—which immediately overlook the river, and on which are placed the fields, gardens, and dwellings of the parish St. Etienne.

One breach, affecting equally all these plateaux, is so large and deep, and so regular in its form, that it resembles in the strongest manner, the deserted bed of a river of magnitude, about to add its waters to those of the lake, contained in the valley at some distant epoch.

The west side of the valley exhibits the same appearances in the steep bank of alluvion four or five hundred feet high, resting on the Middle Hill. This answers to the highest eastern level, and is followed by the inferior terraces; although much disturbed and degraded.

The Malbay river rises near the sources of the St. Maurice, which discharges into the St. Lawrence, ninety miles above Quebec. During its course of several hundred miles through the marshy plains and rocky elevations of the interior, it presents many cascades and rapids. The lowest of the cascades takes place near the sortie from the confusedly grouped hills at the head, or north end of the valley. The river is here about fifty yards broad; it is clear and rapid, with shelving banks of sandy soil, an hundred feet high. A bleak and lofty hill of primary rock is within a few yards on the east; and another is on the west, still higher, with flanks enveloped in alluvion. Up the river,

the view is immediately shut in by a transverse ridge of gneiss.

The fall is narrowed to the breadth of thirty yards and plunges down an inclined descent of ten or twelve feet among large masses of gneiss.

The river now rolls impetuously to the defile inclosed in very deep banks, making frequent and considerable elbows (which every spring enlarges) and branches off into channels, which from time to time coalesce, and separate, forming islands of woods, sand, or cornfields; the different streams being traced with double borders of shrubbery.

Somewhat less than a league to the north of the circular expansion of the valley, and separated from it by high grounds in some state of cultivation, is a lake about a third of a mile in diameter, surrounded by interesting scenery.

It is confined on the east and south by precipices and bold slopes of cedar and pine; while its western and northern sides are moderate ascents of woodland and farms, closed, in the distance by conical mountains.

Two or more miles north of this small lake is another, seated in the midst of woody hills of gentle acclivities and marshy intervals. It is of irregular shape, and about three miles across, in its largest dimension.

A small stream enters it on the north, and another leaves it on the south. Both lakes contain abundance of trout.

The Geologist will find in the district of Malbay, an instructive assemblage of rocks; but, as must have been anticipated, its examination is greatly embarrassed by the uncultivated and often inaccessible nature of the country, by the piles of the larger ruins which encumber the higher grounds, and by the alluvia of the slopes and valleys. The shores of the St. Lawrence, and of the Bay, the sides of the vale of Etienne and the bed of the Malbay river afford almost the only points of observation.

The prevailing rocks are gneiss and mica-slate, plentifully interleaved with a dark limestone, quartz rock, and supporting a calcareous conglomerate of a remarkable kind.

As the rocks of this limited district are nearly of the same age, (excepting perhaps the conglomerate) I shall describe them geographically, and not in any assumed geological succession, commencing with the West Hill.

As far as can be discerned, the body of this hill consists principally of fine white Gneiss, with a sparing proportion

of mica in its composition, this resembling quartz rock, into a semi-crystalline species of which, it frequently graduates, as well as into mica slate, by an increase, on the other hand, of mica.

So little of the gneiss is exposed, that it may be doubted, if the greater portion of it be not of the ribbed or laminated variety, abounding, for many miles on the north shore of the St. Lawrence.

Together with these rocks, a dark limestone occasionally emerges in very short patches, conformably stratified, some yards in thickness, and in one instance incumbent on a crystalline quartz.

The direction of the strata of the body of the hill is seldom easily definable, being brought into view at rare and brief intervals.

It appears to be west south west, at an high, but uncertain angle. Innumerable fissures and displacements of the fixed rocks, together with an extraordinary quantity of debris, have given rise to this obscurity.

A better idea of the structure of the hill, may be gathered from its southern face washed by the St. Lawrence; and from the angle and west arm of the Bay, situations which permit the observer both to follow and to traverse the direction of the strata.

The rocks of the cliff and tubes whose most prominent features have been sketched in an early part of this paper are mica slate and gneiss, affecting the southwest, or south south west direction, and a south west or north north west dip.

They pass into each other at irregular distances, as well longitudinally, as transversely. The transition takes place insensibly in the former direction, the mica slate becoming more compact, and assuming a green hue, which slowly fades into a brownish grey. The rock thus formed, is a laminated gneiss, composed of feldspar and quartz, both brown, almost granular, alternating in their layers with folia of black mica, in laterally aggregated scales. Its veins are numerous and various. They are of largely crystallized white feldspar, interspersed with black mica, and running parallel to the stratification of the gneiss;—or of true granite, traversing the rock irregularly, close-grained and porphyritic in portions, the feldspar being red, and the quartz white. About four hundred yards from the angle of

the bay, a vein one yard thick, of brown compact quartz, advances from the cliff at right angles, to the direction of the gneiss, and diminishing to a point at the water's edge, the line of division being straight, and perfectly well defined. It is remarkable that a few leaves of a crumbling, shaly substance, are interspersed between the vein and its bed, and are parallel to the former. In contact with the west side of this vein, is a deposit of white feldspar in large aggregated rhomboidal crystals. It is of an irregular form, and is about 50 yards long, by 40 yards broad. Fifty yards west of the small cascade, a bed or seam of this kind of feldspar occurs in laminated gneiss; but it is narrow and runs obliquely from the beach into the mountain—visible as a stripe of white fragments for a considerable distance among the ruins of the slope.

The mica slate is in large shining plates of a coppery black colour. It is very splintery on the surface; but not so much so in the occasionally broken pavement of this rock in advance of the cliff to which the salt water has daily access. The mica is often in such great excess, as to exclude every other ingredient, except what appears to be a minutely granular quartz, sparingly disseminated.

The layers are often contorted, and are traversed by veins of different materials, and of different sizes—as of white crystalline quartz; red feldspar; of an aggregate of greenish feldspar, coppery mica and massive garnet: and also of white feldspar similar to that of the beds occurring in gneiss, which here contains six sided prisms of schorl, and four sided oblique prisms of hornblende. In the last instance, the veins are parallel to the laminæ of the mica slate; but in the others in their direction is inconstant.

The gray precipice which forms the immediate angle of the Bay, a few yards in advance of the dark lichen covered primary cliff on the west, is of a similar height with it; but is surrounded by a level space, and not by this usual declivity. At the outer or western end, it sinks perpendicularly down to the beach, unincumbered by debris; but at every other part of the line it is defended from the waves by a base of smooth and bleached mounds of rock, half concealed by fallen masses, mounting midheight and towards the northeast extremity becoming mingled with alluvion, which gives nourishment to a luxuriant shrubbery.

The conglomerate composing the chief part of this precipice, is in strata a foot or more in thickness, abutting against the mica slate in various unconformable positions. At the west end, the layers are very thin, and are placed vertically, with a southwest direction, in some degree of parallelism to the contiguous mica slate. Near this they are contorted, until gradually toward the centre of the range they become horizontal. Here a singular disposition of the upper laminæ is observed. They roof a shallow cave in undulating



lines, which descend gently from above, and after curving upwards for a short distance, decline suddenly on the horizontal strata which constitute the lower half of the sides of the cave. From hence to the north-east end, the cliff seems rather to assume the massive structure than the stratified, but the latter frequently shows itself through its dense envelope of mould and coppice.

In advance of this large precipice, and its northeast extremity, lies another mass of conglomerate extending a short way from the alluvial sides of the hill, fifty yards long, and thirty feet high. It is much shattered and de-ranked. The direction of its layers is very indistinct. On its east face, a set of strata (perhaps displaced) run west of north, and dip east of south at an angle of 70° .

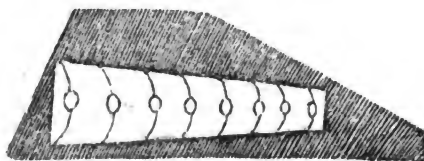
The rock whose position and general aspect has now been detailed, is a conglomerate of a grayish white or

green base, effervescing violently on exposure to acids, and more or less powdery and soft. The nodules which it contains are of milky translucent quartz; and vary from the size of the smallest grain, to that of a child's head; the latter being rare.

They are sometimes so abundant as to be in contact; at others they are in less number. When large, they are frequently arranged in lines. The small granular species resembles in its appearance a loose sand stone; but when of compact texture and free from nodules, it becomes a brown limestone. It often contains imbedded balls of a brown calcareous matter, hard, and of fine grain. It is evidently an independent concretion.

This rock and more especially the coarse grained species, is rich in organic remains of the kind assigned by writers to the transition formations.

A very slight examination discovered four varieties of orthoceratite, in imbedded fragments, differing in the number and construction of their transverse septa, and in the proportion of their length to their breadth. Three of them taper towards one end. The sides of the fourth are parallel. One fragment is three inches broad, seven inches long, and has eight septa. Another is six inches long by one inch in breadth, with five transverse septa and one longitudinal septum dividing it into two equal parts. A third is five inches long, by one and a half broad; and has eight septa, each having a ring or circlet in its centre thus:—



Favosite and chain madreporæ are not uncommon. Encrinites, pectinites, terebratulæ and strombites are particularly plentiful.

The dull brownish blue Limestone, so often instratified with the primary rocks of these mountains is also inclosed in this conglomerate, in single layers, a foot or so thick, or

in sets of ten or fifteen. It is compact, minutely granular, and rather hard. Its fracture is slaty in the large, rhomboidal in the small. It gives a sulphureous odour on percussion, and here and there contains a few shells. Its layers sometimes gradually dilate, or belly out, in portions, and contain some form of the general conglomerate of the cliff. It even occasionally takes the fine crystalline texture of the Limestone of Montmorenci or Point aux Trembles: but this is rare.

A brown or black splintery slate is often interposed between the conglomerate and the dark Limestone; and is plentiful at the Cave.

I had no opportunity of examining the higher parts of the West Hill skirting the Bay: by far the greater portion of it is buried, as before stated, in irregular terraces of alluvion. The breach, however, below, exhibits intervals of the less durable calcareous rocks of the west angle, and not of the primary strata of the Hill, as might have been expected.

At each end of this arm of the Bay, small quantities of the conglomerate are met with;—not to be distinguished by the eye, from Grey wacke, on account of the faint green colour of its base.—Near the outer precipice, it is much interleaved with the dark limestone; and contains a few shells.

In a grassy meadow, near the church, a more compact form of the conglomerate emerges from the soil in slabs inclining to the south-south-west at an angle of 25° , a dip which I believe to be accidental from the extreme disorder of some contiguous strata of dark Limestone. There is another portion at the foot of the Middle Hill, near some low mounds of porphyritic grey gneiss.

Several patches of the dark Limestone occur on the beach, two of them being four or five hundred yards in length.

Like the Mica-slate of the Hill, it dips to the north-north-west at an high angle, excepting the large mass alluded to above, which inclines, in groupes of strata, in every possible direction.

I did not observe any organic remains in the Limestone here, nor other accidental mineral, excepting white calc spar, which often traverses the rock so plentifully in slender veins, as to give it a brecciated appearance.

The alluvion of the Middle Hill suffers but few strata to shew themselves. Those at the back of the cluster of houses, near the church, are the gneiss and calcareous conglomerate just mentioned.—The dark Limestone is the only rock I met with on the east side of this Hill, or that flanking the valley of St. Etienne.—For six miles it is seen at all levels; but in the clearest manner, in the numerous gullies and in the banks and bed of the river. About four miles from Malbay Church I traced it in a gulley on this side of the valley for four hundred feet. It is there usually disposed horizontally; but it is in many places inclined.—Near the top of this height, it wears the rounded, smooth, and dough-like shape of water-worn granite, together with great indistinctness in the divisions of the Laminæ.

With respect to the rocks in the more remote interior, it may be here remarked, that the incumbered state of the surface is such as to preclude any examination of them.—At the lesser lake, they are primary; and also in the neighborhood of the first fall in the Malbay River, where they are coarse and shattered gneiss running south-south-west, and vertically, I believe. In one example, it contains a vein of chlorite, running parallel to its stratification.

The rocks of the Eastern Hill are also greatly obscured by the alluvion of its sides; and by the dense vegetation and debris of its summit; but in the latter situation, where it overlooks the Bay, occasional ridges of white quartz crop out and run nearly north. The texture is crystalline, but now and then becomes granular; and even of a conglomerated form.

The rocks of the high and naked grounds in the rear of this, appear, on distant inspection, to be primary; but as in a former case, the shores at the base of this hill will best elucidate the geology of this locality.

A shingled beach skirts the east side of the Bay, but at the point where the shore first inclines strongly into the general course of the St. Lawrence, a rapid succession of rocks takes place.

The first met with, is a collection of strata of knotty greenstone, with a south-west direction and a dip, either vertical or to the south-east. It is much veined by true granite, containing hornblende and garnet. This greenstone extends along the beach for 150 yards, and gradually becomes gneiss, (towards the hill it is immediately buried

in alluvion.) An interval of shingle having taken place for fifty yards, a nearly pure quartz follows, much fractured. It retains the south-west direction and the south-east or vertical dip, and extends for 100 yards, protruding from the contiguous hill, whose summit is composed of it.—Now and then it is seamed by a dark quartz, mixed with mica; the walls of the seam being very ill defined.

Close to this, (proceeding eastward along the beach,) covering and intermixing with it, is a horizontal stratum of quartzose puddingstone, with small scales of white mica. It soon passes into the form of the calcareous conglomerate and contains a few shells. It is only an insulated fragment, ten feet broad, by five in height, probably incumbent on the vertical quartz, which is now resumed for twenty yards, when it disappears under the shingle.

One hundred yards to the east, there is a low tongue of land, about three hundred yards across, and two hundred long. Its beach is wholly occupied by the dark limestone, its strata dipping in long undulating curves, or in short broken masses in every imaginable direction. This limestone possesses a few shells, and has many knotty protuberances, six inches high, by a foot or more in diameter. Their surface and interior are marked with indistinct appearances of the capillary sea weed, which, fixed to some rock, streams in the tide.—Large globular concretions are abundant, similar to those in the white limestone of Lake Huron, and of composition similar to that of the containing rock.

In the rear of this projecting point, and somewhat to the east, is a gentle alluvial ascent, crowned by broken ledges of calcareous conglomerate, passing into sandstone;—themselves again surmounted by a steep round-backed hill.

Passing eastward a very short distance, we find the sea encroaching gradually on this alluvial ascent until it bathes the foot of its conglomerate ledge, which now, two hundred feet high, forms the immediate shore, fronted, and half buried by the usual pile of ruins. Its west end is not far from the last of the confused layers of limestone, where it becomes now and then interleaved with a browner and somewhat crystalline limestone; and still nearer, with the green variety of the conglomerate so closely resembling grey wacké, both rocks observing the accidental direction of the accompanying strata.

The face of the precipice is nearly perpendicular ; the upper parts overhanging a little ; and the layers undulating, but never departing widely from the general horizontality of the rock.

The cliff is of a mixed character. Near the east end a fissured mass of porphyritic granite twelve feet high, and as many broad, rises from the loose sand of the beach, and passes under the precipice, into the hill. Near it, but not in contact, a coarse quartz rock does the same ; but not attaining more than four or five feet above the level of the water ; and is surrounded by broken strata of the green conglomerate lately spoken of, which covers the beach along the whole front of the precipice.

The cliff itself is composed of calcareous conglomerate, interleaved with a brown limestone, as in that of the west angle of the bay :—the only difference which I observed is, the predominance of the conglomerate in the lower parts, and of the limestone in the upper ; which latter is brown, and remarkably full of shells. I observed an orthocerite with a pointed termination ; but in other respects similar to those previously noticed : I do not recollect whether it occurred in the conglomerate or in the brown limestone, rocks which perhaps differ only in the presence or absence of quartz nodules.

The conglomerate is occasionally interspersed with small rounded flakes of black clayey matter, as in the grey wacke of Ange Gardien, and of Cap Rouge, near Quebec.

The precipice is discontinued suddenly, and is replaced to the east by a slope of gneissic ruins. On the beach a whitish laminated gneiss prevails at various angles of inclination, but always dipping north north-west under the hills. The mica of the gneiss, as we proceed east, very gradually increases, and hornblende and garnets in crystals become numerous. At length the rock is changed into a coarse black mica slate. The garnets now for several hundred yards towards Cape Eagle are so abundant as to form the greater part of the rock. They are either obscurely crystallized or massive ;—instances of either form eight inches in diameter being common. Their texture is much loosened by rents ; and many have fallen from their nests : It is difficult to procure large specimens from their fragility, and from the toughness of the rock in which they are imbedded.

This mica slate is often tolerably compact. It is full of quartz veins, and of the beds of white feldspar, as on the outside of the west arm of Malbay. Its layers are, as is usual, very tortuous, but like the gneiss, they affect on the whole the north north-west dip.

Half a mile from the conglomerate precipice the gneiss is resumed, and continues for a great distance to dip into the water in impassable mounds. I observed it at the Riviere des Trois Saumons, nine miles below : where it has a transverse vein of calcspar, mottled white, green, and red, eighteen inches thick, and intersected obliquely by a vein of white quartz six inches thick.

The details which have now been entered upon at some length, suggest the following observations :—

The rock formations of the north shore of the St. Lawrence from Cape Torment, a precipitous headland 1,800 feet high, to the River des Trois Saumons, are of a character similar to that of the district of Malbay. They rise into mountains of magnificent features, which bound the river in lofty capes and escarpments, and at distant intervals break into rich but narrow valleys of alluvion, the outlets of streams tributary to the St. Lawrence.

Almost all the primary rocks are found in this distance alternating in rapid succession, and thus contrasting in the most forcible manner with the vast and monotonous tracts of gneiss, limestone, and marble of Upper Canada.

The rocks of Malbay are, with one exception, of the ordinary kinds, but they are remarkable in their transitions and position.

These transitions are effected in different ways, as gradually and longitudinally (that is, in the direction of the stratum) in the primary rocks, one ingredient mica for instance, slowly predominating to the exclusion of another. Thus the laminated gneiss of the West Hill becomes well characterised mica slate, and by the addition of hornblende, undergoes a still greater change in the east of Malbay. This appearance has been rarely noticed by authors. Dr. Macculloch met with it in the Isle of Sky in the West of Scotland, and considers it to be of difficult explanation, but shews it to occur in other formations. Professor Kidd

gives a striking instance of it in the secondary rocks of England.

The transverse and more common mode of slow transition is present every where.

The sudden alternation of entirely dissimilar strata, as of gneiss and limestone, is frequent. It is strikingly exemplified in the channelled fissure of some extent, which a mountain stream has worn in the face of a precipice at the Bay of St. Paul, thirty miles west from Malbay. In the walls of this fissure or gulley, conformable layers of these substances alternate several times in the space of eighty yards. They incline to the west south-west at an angle of 70° . The limestone has occasional seams of white crystalline marble, beautifully clouded with green, and containing disseminated galena. These rocks are unchanged at their well defined point of contact.

The frequent alternations of the gneiss, quartz, limestone, &c. of Malbay, shews them to be of the same age; it is remarkable however that the limestone of the highlands and the dark conchiferous species of the beach are quite similar in composition, although of very different dates, a fact which involves nothing absurd or even improbable, as almost every rock in the geological catalogue recurs at intervals, and with the same characters.

The limestone appears to occupy the flanks of the hills. I never saw it higher on the north shore, than 800 or 1,000 feet above the sea. The summit of the mountains is always primary:—that of Cape Torment is of the finest graphic granite.

While these strata affect more or less a south-west direction, they do not enwrap or abut upon the mountains, but dip towards them,—a very extraordinary disposition, of which I know but four instances. It was noticed by Saussure on the Grimsel and in the valley of Chamouni.

Von Buch met with it in the primitive mountains of Norway; and Macculloch, also, in the western islands of Scotland. This dip extends along the north shore of the St. Lawrence for thirty miles, and is the more singular from being surrounded by rocks of the opposite inclination.—Almost all the older rocks of the Canadas have assumed the latter position, as the primitive rocks of the Thousand Islands near Kingston, and those on the north and east of Lake

Huron, and the greywacke, clay slate, and quartz rock of the south side of the St. Lawrence from Camourasca to Quebec, together with the gneiss of Montmorenci, Auge Gardien and Cape Torment.

The marble, greenstone, and large grained gneiss of the River Ottawa run somewhat more westerly, but they are so obscured by weathering, alluvion and vegetation, that it is difficult to detect their real position.

From the rocks of Malbay and Camourasca, two opposite points in the south and north shores of the St. Lawrence, being totally different, this river seems to bound or separate two formations, as Von Buch observed in the fiord of Christiana in Norway, and elsewhere, and as is the case with Lakes Superior and Huron in Canada.

The calcareous conglomerate of Malbay presents several peculiar appearances.

Its resemblance to greywacke in its associations and external characters is so perfect that for some days I considered it as such, but was undeceived by its violent effervescence on exposure to acids.

This rock is also interposed between the black fetid limestone and the gneiss of the Falls of Montmorenci, and in all probability passes into genuine greywacke as the latter is formed in horizontal strata less than a mile to the east of the Falls, and nearly at the same level. The grey wacke likewise occupies the south-east of Quebec in large tracts.

The Pictured Rocks of Lake Superior, so splendidly described by Governor Cass in his notes to the poem of *Ontawa* are of this substance.

At Malbay it is unconformable to the primary rocks on which it abuts, and is perhaps the most recent, from, in addition to its horizontality, its containing organic remains and water-worn nodules.

The curvature of the strata at the cave in the west angle of the Bay, and of the east shore of the Bay, is worthy of observation. They are an additional evidence shewing the temporary flexibility of rocks, after consolidation, and their disturbance while in that condition. The most singular contortions on a large scale, that I recollect, are the curved gneiss of the Western Islands, figured by Maculloch, and the almost spherical limestone discovered at La Forme in Switzerland, by Dolomica. At the mouth of the

River Grand St. Anne, 24 miles below Quebec, three strong seams of gray wacke form as many concentric arches, in the face of a naked and perpendicular bank, the outer of which is about eight feet high, and twenty-two feet span. The surrounding shale observes the same position.

At the bridge of the river Jaques Cartier, 30 miles above Quebec, there is a beautiful natural arch of blue limestone of similar dimensions.

The occurrence of comparatively uninjured organic remains in a minute conglomerate is a remarkable circumstance, and shews that the shells, encrinites,* and orthoceratites have not been subjected to the same attrition as the quartzose nodules.

These orthoceratites shew in what a qualified sense must be taken the rule which determines the æra, and other relations of rocks from their contents. Parkinson, Greenough, and Kidd, have expressed an accordance with this opinion, without entering into proof. My own experience in North America, leads to the same conclusion. The orthoceratites are astonishingly numerous, large and varied in the greenish grey and brown limestones of Lake Huron, in the yellowish grey of Lake Erie, in the blackish blue of the northern and southern shores of Lake Ontario, and of the Falls of Montmorenci, in the brown and lead-coloured beautifully crystalline variety of Point aux Trembles, and Jacques Cartier, ten leagues above Quebec, and lastly in the calcareous conglomerate of Malbay—substances of marked dissimilarity under every aspect, geological and mineralogical.

The alluvial depositions which have been noticed in the romantic valley of St. Etienne, attract particular regard only from their quantity and regularity of disposition. They furnish a most gratifying and instructive lesson to the young geologist, and seem to indicate four conditions of the river Malbay, with respect to size, each (it may be supposed) being assumed, successively from the highest, as the barrier between the valley, and the St. Lawrence, has received some great injury.

* It is singular that no lily encrinites so numerous in England, have been found in the vast secondary tracts of North America. I know only of one Echinite also—from Onondaga, New-York, I believe. It is in possession of J. G. Bogert, Esq. New-York.

They are clearly the work of the present river; but when its bottom and surface have been at very different levels from the present. The country to the north west, from whence the materials forming these hills have been drawn, is not universally, as Hayden, in his spirited, useful, but ill-digested work supposes, naked, and soil-less from the devastations of a debacle, but abounds in alluvial plains of immense extent, and some so fertile, as to have induced the Jesuits to plant gardens and vineyards there, as on the low rich banks of the Lake St. John, of the Saguenay River, Lake Tematscaming, and in the rear of the mountains of Malbay and St. Paul, to the last of which situations, the Canadian peasantry, sluggish and unobservant as they are, were induced to remove. The length and severity of the winter, however, and the solitariness of these wild regions, have compelled them to return to their friends around Quebec.

The great primitive floods, appear to have been in some measure partial; their force and direction being modified by the nature of the ground over which they flowed. Thus, much of the northwest is a vast assemblage of debris, without soil, and without vegetation, as on the River des Francois, the coast of Labrador, and the barrens of Hearne. It is singular that among the incalculable quantities of detached rocks which load the district of Malbay, I met with only two specimens of the clay slate of Camourasca, on the opposite side of the St. Lawrence; and a similar number in the Eboulements, while in Upper Canada the jasper conglomerate of the Northwest of Lake Huron overspreads all the *high grounds* of that large body of water.

The epidotic Greenstones, the greenstone porphyries and other peculiar rocks of the same lake, are plentiful, as rolled masses in Lake Erie, at the foot of Lake Superior, the rapids of Hawksbury on the river Ottawa, an extent of country exceeding 1000 square miles. The trap of Montreal is found loose, on the shores of Lakes Francis and Champlain, localities to which the existing rivers could not have conveyed them, as their current observes the opposite direction.

JOHN I. BIGSBY, M. D.

ART. II.—*Remarks on the Prints of Human Feet, observed in the secondary limestone of the Mississippi valley.*

TO PROFESSOR SILLIMAN.

Buffalo, (N. Y.) June 5th, 1822.

SIR,

I now send you a drawing of two curious prints of the human foot in limestone rock, observed by me last summer, in a detached slab of secondary formation, at Harmony, on the Wabash; together with a letter of Col. Thos. H. Benton, a senator in Congress from Missouri, on the same subject. The slab of stone containing these impressions, was originally quarried on the west bank of the Mississippi river, at St. Louis, and belongs to the elder flötz range of limestone, which pervades that country to a very great extent.

These prints appear to have been noticed by the French soon after they penetrated into that country from the Canadas, and during the progress of settlement at St. Louis, were frequently resorted to as a phenomenon in the works of nature. But no person appears to have entertained the idea of raising them from the quarry with a view to preservation, until Mr. Rappe* visited that place five or six years ago. He immediately determined to remove the stone containing them to his village of Harmony, then recently transferred from Butler county in Pennsylvania, to the banks of the Wabash; but this determination was no sooner known than popular sentiment began to arraign his motives, and people were ready to attribute to religious fanaticism or arch deception, what was, more probably, a mere act of momentary caprice, or settled taste. His followers, it was said, were to regard these prints as the sacred impress of the feet of our Saviour. Few persons thought of interpos-

* The Rev. Frederick Rappe is the ecclesiastical head of a religious sect called *Harmonites*, who emigrated from the kingdom of Wirtemberg, in Germany, about the year 1804. They first settled in Western Pennsylvania, where they introduced the cultivation of the vine. Their industry, sobriety, neatness, and orderly conduct soon attracted universal notice, but increasing rapidly in wealth and numbers, they afterwards (about 1814) removed into Indiana. H. R. S.

ing a charitable remark in favour of religious tenets, of which we can judge only by the peaceful, industrious, and devotional lives; the neat and cleanly appearance; and the inoffensive manners of those who profess them. Still less could be conceded in favour of a personal taste for objects of natural history or curiosity, of which this act is, at least, a proof. Be this as it may, Mr. Rappe contracted with a stone mason to cut out the block with the impressions, paying him at the same time a liberal price for his labour, and ordered it to be transported by water to his residence in Posey county, Indiana. Visiting this place during the last summer, in the suite of Governor Cass, Mr. Rappe conducted us to see this curiosity, which has been placed upon mason work in a paved area between his dwelling house and garden, in the manner represented in figure II. of the drawing.* The slab of stone thus preserved, forms a parallelogram of eight feet in length, by three and a half in breadth, and has a thickness of eight inches, which appears to be the natural thickness of the stratum of limestone rock, of which it is a part. This limestone possesses a firm and compact structure, of the peculiar greyish blue tint common to the calcareous rocks of the Mississippi valley, and contains fossil encrinites, and some analogous remains, very plentifully imbedded. It is quarried at St. Louis, both for the purposes of building stone, and for quicklime. It becomes beautifully white on parting with its carbonic acid and water, and those who have used it, observe, that it makes a good cement, with the usual proportion of sand.

The prints are those of a man standing erect, with his heels drawn in, and his toes turned outward, which is the most natural position. The distance between the heels, by accurate measurement, is $6\frac{1}{4}$ inches, and between the toes, $13\frac{1}{2}$ inches: but it will be perceived, that these are not the impressions of feet accustomed to a close shoe, the toes being very much spread, and the foot flattened in a manner that happens to those who have been habituated to go a great length of time without shoes. Notwithstanding this circumstance, the prints are strikingly natural, exhibiting every muscular impression, and swell of the heel and toes, with a precision and faithfulness to nature, which I have not been able to copy, with perfect exactness, in the

* See the Plate at the end.

present drawing. The length of each foot, as indicated by the prints, is $10\frac{1}{2}$ inches, and the width across the spread of the toes, 4 inches, which diminishes to $2\frac{1}{2}$ inches, at the swell of the heels, indicating, as it is thought, a stature of the common size.*

This rock presents a plain and smooth surface, having acquired a polish from the sand and water, to which its original position periodically subjected it. Upon this smooth surface, commencing in front of the tracks, there is a kind of scroll, which is two feet and a half in length. The shape of this is very irregular, and not equally plain and perfect in all parts, and would convey to the observer the idea of a man idly marking with his fingers, or with a smooth stick, fanciful figures upon a soft surface. Some pretend to observe in this scroll, the figure of an Indian bow, but this inference did not appear, to any of our party, to be justified.

Every appearance will warrant the conclusion that these impressions were made at a time when the rock was soft enough to receive them by pressure, and that the marks of feet are natural and genuine. Such was the opinion of Gov. Cass and myself, formed upon the spot, and there is nothing that I have subsequently seen to alter this view: on the contrary, there are some corroborating facts calculated to strengthen and confirm it.† But it will be observed

* These measurements were made July 19th, 1821, in the presence of His Excellency, Lewis Cass; the Rev. Fred. Rappe, the younger; and Maj. Robt. A. Forsyth, of Detroit. H. R. S.

† The following are the facts referred to. At the town of Herculanum in Jefferson county, Missouri, two supposed tracks of the human foot were observed by the workmen engaged in quarrying stone in the year 1817. These impressions, at the time, attracted the general notice of the inhabitants, and were considered so curious and interesting that the workmen who were employed in building a stone chimney for John W. Honey, Esq. of that place, were directed to place the two blocks of stone containing these marks, in the outward wall, so as to be capable of being examined at all times. It is well known to those who have visited that section of country, that the custom of building the back walls and the pipe of the chimney, in such a manner as to project beyond the body of the house, is prevalent among the French, and other inhabitants; and consequently, the above arrangement, while it completely preserves, at the same time exposes the prints to observation, in the most satisfactory manner. I examined them in that position on my first visit to Missouri, in 1818, and afterwards in 1821, when I took drawings of both the prints. They are however the impressions of feet covered with the Indian shoe, and are not so perfect and exquisitely natural as those at Harmony. They were situated in the same range of secondary limestone, and distant from St. Louis, 30 miles.

by a letter which is transmitted with these remarks, that Col. Benton entertains a different opinion, and supposes them to be the result of human labour, at the same period of time when those enigmatical mounds upon the American Bottom, and above the town of St. Louis, were constructed. The reasons which have induced him to reject the opinion of their being organic impressions are these :

- "1. *The hardness of the rock.*
- "2. *The want of tracks leading to and from them.*
- "3. *The difficulty of supposing a change so instantaneous and apropos, as must have taken place in the formation of the rock, if impressed when soft enough to receive such deep and distinct tracks."*

To those who are familiar with the facts of the existence of sea and fresh water shells, ferns, madrepores, and other fossil organic remains, in the hardest sandstones and limestones of our continent, the *hardness* of the rock, and the supposed *rapidity* of its consolidation, will not present objections of that force, which the writer supposes.* But

Several tracks of the human foot are reported to exist upon the rocks between Esopus landing and Kingston, on the Hudson. Chas. H. Ruggles, Esq. Representative in Congress from Kingston, to whom I mentioned this report, has no knowledge of the fact.

A detached block of stone near the residence of Com. Rogers, at the city of Washington, has been frequently resorted to, on account of its bearing the supposed prints of the human foot. I have recently visited, and made a cursory examination of this stone, in company with Dr. Darlington of Pennsylvania, and Albert H. Tracy, Esq. of N. York, both Representatives in the present Congress; but am not prepared to describe it. H. R. S.

* The following interesting fact, touching the history of secondary rocks, has just come to light. The workmen engaged in blasting rock from the bed of the Erie Canal, at Lockport, in Niagara county, lately discovered in a small cavity in the rock, a toad in the torpid state, which on exposure to the air instantly came to life, but died in a few moments afterwards. The cavity was only large enough to contain the body, without allowing room for motion. No communication existed with the atmosphere: the nearest place of approach to the surface was six inches, through solid stone. It is not mentioned whether the rock was sandstone, or limestone; but from the prevalence of limestone on the surface of the contiguous country, it may be presumed to be the latter: the country is wholly of secondary formation. These animals have frequently been found imbedded in clay, gravel, &c. but no fact of their having been observed *in rock*, is recollected. Of the causes which enable animals of this class, which have been suddenly enveloped in strata of earth, or otherwise shut out from the air without injury to the animal organs, to resume, for a limited period, the functions of life, on being restored to the atmosphere, no explanation need here be given, as

the want of tracks leading to and from them, presents a difficulty, which cannot, perhaps, be so readily obviated. We should certainly suppose such tracks to exist, unless it could be ascertained that the toes of the prints, when in situ, pointed inland, in which case we should be at liberty to conjecture, that the person making them, had landed from the Mississippi, and proceeded no further into the interior. But no enquiry has enabled me to ascertain this fact, the circumstance not being recollected by Col. Benton, and others, who have often visited this curiosity while it remained in its natural position at St. Louis.

The following considerations, it will be seen, are stated by Col. Benton, as capable of being urged in opposition to his theory of their being of factitious origin.

“1. *The exquisiteness of the workmanship.*

“2. *The difficulty of working such hard material without steel or iron.*”

The strikingly natural appearance of these prints, has always appeared to me, to be one of the best evidences of their being genuine; for I cannot suppose that there is any artist now in America possessed of the skill necessary to produce such perfect and masterly pieces of sculpture: yet, what are we to say of the skill of that people, who are supposed to have been capable of producing such finished pieces of art, without the aid of iron tools? For, let it constantly be borne in mind, that the antiquity of these prints can be traced back to the earliest discovery of the country, and consequently to the introduction of iron tools and weapons among the aborigines. There are none of our Indian tribes who have made any proficiency in sculpture, even since the iron hatchet and knife, have been exchanged for those of flint, and of obsidian. All their attempts in this way are grotesque, and exhibit a lamentable want of proportions, the same which was seen in the paintings, and in the figured vases and pottery of the Asteecks

the occurrence is a very common one, and is perhaps always, more or less, the result of galvanic excitement. But one conclusion seems naturally to be suggested by this discovery: if secondary rocks, as Hutton and Playfair have taught, have been consolidated by fire, would not the animal here incarcerated, have been consumed, or at least, such an effect have been produced, upon the animal organization, as to prevent resuscitation? H. R. S.

of Mexico, when their towns and temples were first visited by the Spanish conqueror.

These remarks, and the papers which are designed to illustrate them, are submitted without further comment, in the hope that the novelty of the facts, at least, will recommend them to the consideration of those who take an interest in the geological antiquities of our continent, and whose opportunities of information qualify them for the discussion, in a manner that I cannot presume to be.

Yours, with respect,

HENRY R. SCHOOLCRAFT.

TO THE HON. THOMAS H. BENTON, OF MISSOURI.

Washington, April 27th, 1822.

SIR,

“Understanding that you have seen the prints of human feet in the limestone rock, which forms the western shore of the Mississippi river, at St. Louis, and that you entertain peculiar views in regard to them, I beg leave to solicit your reply as to the fact of the existence of those impressions, in situ, at the place indicated; the time at which they were first discovered by the inhabitants, and the subsequent removal of the stone, with such opinion as you may think proper to communicate respecting their origin, and the conclusions to be drawn.

“It is very remarkable that no analogous appearances have been disclosed by the rock strata of any other part of the world: at least, we are not informed that any well authenticated discoveries of the fossil remains or impressions of man, have ever been made, which prove the existence of the species before the consolidation of existing rocks.* But such, it appears to me, is the inevitable conclusion to be drawn, if we are prepared to admit that these prints were produced by the pressure of the human foot upon those secondary strata, during their soft, or semi-pasty state.

“When we reflect upon the period of time which has elapsed since the Mississippi country has been known to

* The fossil human bones of Guadalupe, are not conceived to form an exception to this remark. They are contained in a porous, shelly rock, or a kind of tufa, of very recent and local formation.

H. R. S.

Europeans, and the great number of persons, both men of science, as well as men of business, who have visited the town of St. Louis since its transfer to the United States, it is not less remarkable that a circumstance so perfectly *unique* among natural objects, should not, ere now, have elicited that notice, which the increasing taste for natural science in this country, appears to claim for it. It is the more to be regretted that this inquiry has been permitted to sleep, until the stone itself containing these impressions, having attracted the attention of a religious sect, has been conveyed into a distant part of the country, and there preserved for purposes, which many are free to declare, are totally independent of all scientific considerations.

“The circumstances of this removal, and the insulated state in which only it can now be seen, leave room for doubts, respecting its original position at St. Louis, which no testimony less certain than that of an eye witness of the scene, is calculated completely to remove. It is therefore more with the view of establishing the existence of the facts, than of offering any speculations which may arise from them, that these remarks are commenced; and I hope sir, the subject may be sufficiently within your recollection, and means of observation, to permit you to state, in reply, the principal facts and appearances.

“The new and interesting views which this discovery is calculated to suggest in regard to the natural history of stratified rocks, and particularly with reference to the geological age and character of the Mississippi valley, must present themselves in the most clear and striking manner to those who have been particularly accustomed to reflect upon these subjects, and will readily occur to you. We infer the different eras, and deduce the character of secondary rocks, with considerable certainty, from the fossil organized bodies which they disclose in the most solid parts. We perceive from the shells, corallines, and other traces of organic structure which are found, that these rocks were once soft and pliable, so as to be capable of admitting these bodies. We point to the fossil trees, and shrubs, and to the beds of mineral coal having vegetable impressions, as evidences of the destruction of forests, which once flourished upon the older series of rocks. The bones of the mastodon, the horns of elks, and the osseous and undecomposed remains of other large quadrupeds, birds, fish, and

reptiles, which are abundantly found, not only in the alluvial soils, but also occasionally in the rock strata of Europe and America, sufficiently indicate the revolutions and changes which the earth's surface has undergone at comparatively recent periods. We wish only to discover the remains of man, in similar situations, to date these changes subsequent to the Mosaical period of his creation; and here, apparently, we have found them! But the facts demand a careful investigation.

"The drawings which I have taken of these impressions, the inspection of the original, now at Harmony, and the best reflections I have been able to bestow upon attending facts and circumstances, concur in my mind, to establish the conclusion, that they are natural, and genuine; and consequently, that the discovery should be seized upon to erect a new genus of organic remains, of which the specific type should be any portion of the human frame, recognized in the anatomical nomenclature: But it is not conceived to be necessary here, to state the circumstances which induce me to consider these prints as the result of a local submersion of the country extending north of the Grand Tower* on the Mississippi.

"I have the honor to be sir,

With high respect,

Your most obedient servant,

HENRY R. SCHOOLCRAFT."

Col. Benton in Reply.

"Washington City, April 29th, 1822.

"SIR,

"Yours of the twenty-seventh was received yesterday. The "prints" of the human feet which you mention, I have seen hundreds of times. They were on the uncovered limestone rock in front of the town of St. Louis. This rock forms the basis of the country, and is deposited in horizontal strata, and in low water is uncovered to the extent of three miles in length on the bank of the Mississippi, and, in some places, from one to two hundred feet wide.

* I am not able to refer to any adequate description of this bold and picturesque feature in the geology of the Mississippi valley. It is cursorily mentioned in my View of the Lead Mines of Missouri. H. R. S.

“The “prints” were seen when the country was first settled, and had the same appearance then as now. No tradition can tell any thing about them. They *look* as old as the rock. They have the same fine polish which the attrition of the sand and water have made upon the rest of the rock which is exposed to their action. I have examined them often with great attention. They are not handsome, but exquisitely natural, both in the form and position, spread-toed, and of course anterior to the use of narrow shoes. I do not think them “impressions,” but the work of hands, and refer their existence to the age of the mounds upon the American Bottom, and above the town of St. Louis. My reasons for this opinion are: 1. The hardness of the rock: 2. The want of other tracks leading to and from them: 3. The difficulty of supposing a change so instantaneous and apropos, as must have taken place in the formation of the rock, if impressed when soft enough to receive such deep and distinct tracks. Opposed to this opinion are: 1. The exquisiteness of the workmanship: 2. The difficulty of working in such hard materials without steel or iron.

“A block of 6 or 8 feet long, and 3 or 4 wide, containing the “prints,” was cut out by Mr. John Jones, a stone mason in St. Louis, and sold to Mr. Rappe of Indiana, and, under his orders, removed to his establishment, called Harmony, on the left bank of the Wabash.

“Very respectfully yours,

“THOMAS H. BENTON.

“HENRY R. SCHOOLCRAFT.”

ART. III.—*An Outline of the Geology of the Highlands, on the River Hudson*—By Prof. AMOS EATON.

SEVERAL sketches of the geology of the Highlands have already been published. The best, which has come to my knowledge, is that of Dr. Akerly, accompanied with a profile view. But Dr. A. told me, that his sketch was drawn up in haste, without a personal examination of the whole succession of strata which constitute this stupendous pile of mountains.

Having been invited to perform some subordinate services at the Military Academy at West Point, a very eligible opportunity was afforded for examining the rock formation in its immediate vicinity. The superintendant, Major Thayer, Dr. L. Foot, Professors Douglass and Cutbush, and myself, crossed the whole breadth of the Highlands, during the month of May last, which is fourteen miles, and continued our examinations so far as to become acquainted with the adjoining rocks on both sides. As the river Hudson crosses this range of mountains from north to south, cutting them down to their very base, each shore of the river presents a very advantageous view of their strata. Accordingly we coasted along each shore in a barge, taking specimens wherever there was the least appearance of any change.

The following is the result of our investigations, given without regard to the order of time in which they were made.

The middle portion of the Highlands for ten miles in extent, taking Buttermilk Falls (two miles below the military academy) for the center, consists almost wholly of well characterized gneiss, with alternating layers of granite. There are also some beds and some alternating layers of hornblende rock, included in it.

These ten miles of gneiss are succeeded, both on the north and south, by hornblende rocks; each about two miles in extent. The true hornblende rocks sometimes alternate with a kind of rock resembling gneiss, in which very dark-coloured lamellar hornblende seems to be substituted for mica. Such are the rocks constituting Butterhill and Dunderbergh.

At the termination of the hornblende rocks, which is the termination of the mountains both north and south, the transition argillite commences. As far as we examined it, we found it alternating with transition (or metalliferous) limestone, and graywacke. The latter contains petrifications of terebratulites and orthocerites.

We found, that the layers of all the rocks in the range, whether primitive or transition, inclined toward the northwest, from a vertical position. We could find no place whereon to fix, as the middle range, or granitic range, from which to trace a succession of strata on each side, accord-

ing to the Wernerian arrangement. It would rather appear as if the gneiss rocks, ten miles in breadth, were the central or oldest formation ; and that, beginning with this rock, we could trace corresponding strata on each side.

After this *general* view of the rocks constituting the Highlands, a more particular account will be readily comprehended.

The granitic layers embraced in the gneiss consist chiefly of no small proportion of semi-transparent quartz of a hyaline appearance, a very little silver-coloured mica, and a large proportion of greyish-white feldspar of a pearly lustre. In a few limited localities the feldspar is flesh-coloured. Sometimes the quartz is very dark coloured ; and in some rocks the feldspar appears of a sky-blue colour.

The mica of the gneiss is almost invariably black, and the feldspar white. Beds of considerable extent are embraced in the gneiss rock near Fort Putnam, which consist chiefly of hornblende. In this rock are found imperfect crystals of green augite of a large size, and considerable quantities of the green coccolite variety.

Where the gneiss meets the hornblende rock stratum, both north and south, many interesting minerals are disseminated. The most beautiful specimens of serpentine in calc spar are found at this meeting of the strata, three miles north of the military academy. They appear like grass-green gems set in masses of pearl.

Vast quantities of very dark lamellar hornblende appear in the form of veins traversing the hornblende rocks. The same variety of hornblende is disseminated in the granitic layers included in the gneiss rocks ; which is often mistaken for shorl on a slight view of the rocks. It sometimes gives the granite a graphic appearance.

Those geologists, who study hand specimens in the cabinet and are disposed to multiply names, may here find the primitive trap, primitive greenstone, sienite, greenstone porphyry ; and perhaps every other variety into which the hornblende rock is varied in any country.

The granulated iron ore containing small crystals of phosphate of lime which abounds in the gneiss rocks of these mountains, together with the carburet of iron, with other minerals, have already been mentioned in former publications. The minerals of these mountains, however, have

not been thoroughly searched out. One object of this essay is, to furnish to the industrious mineralogist those landmarks which an outline of the rocks may afford.

We found no well characterized mica-slate in the Highlands. But the gneiss becomes more slaty about half a mile north of Fort Montgomery, which is four and a half miles south of the Military Academy. It would probably be called mica-slate by some geologists, though it always contains a considerable portion of feldspar. It is highly ferruginous, and tends rapidly to a state of disintegration. It seems to contain considerable soft granulated sulphuret of iron. Similar localities of small extent are found near the Military Academy. Blocks of this variety are laid in the walls of some of the public buildings, which are soon disintegrated ; staining the walls before them of a yellow ferruginous hue.

We discovered a vertical layer of a slaty rock set in the gneiss rock, which is, in all respects, similar to gray wacke slate. It is firmly set in the base of the Dunderbergh hill, on the east side of the river. A layer considerably resembling this, though not quite so well characterized, is to be seen among primitive rocks in the adit to Southampton lead mines in Massachusetts. See Index to the *Geology of the Northern States*, 2d Ed. page 20 ; and *American Journal of Science*, Vol I. page 136. Such anomalous formations ought to be attentively studied.

The transition rocks bounding the Highlands on the north and south, bear a strong resemblance to the range of a similar formation along the western foot of the Green Mountains of Vermont and Massachusetts. Maj. Rensselaer Schuyler having transported vast quantities of the metalliferous lime stone rocks from Barnagat, near the north side of the Highlands, for building the great sloop lock in Troy, I had a very favourable opportunity for examining it. It is of a bluish-gray colour. somewhat granulated, and often traversed by veins of white calc spar. It is often cellular, and contains numerous geodes, lined with crystals of quartz. Geologists who travel on the canal, are requested to notice a remarkable circumstance in Schuyler's lock, respecting the meeting of the layers in the rock. They meet and unite by sutures precisely like the bones of the human cra-

nium. The veins of the calc spar are nearly at right angles with the sutures.

It is a remarkable fact that the specific gravity of this rock, (which is 2.86,) the cells, the geodes, the calc spar, crystals, and the quartz crystals, are similar to those of a transition granular quartz rock in Rensselaer county, almost one hundred miles from Barnagat. A fair opportunity for making the comparison will probably remain at Schuyler's lock for ages; as the faced stones are from Barnagat and the back stone from the granular quartz in Rensselaer county.

Most respectfully,

AMOS EATON.

Prof. BENJ. SILLIMAN.

Troy, July 3d, 1822.

ART. IV.—*Description and Analysis of a new Ore of Zinc*; by JOHN TORREY, M. D. of New-York. (*From the New-York Medical and Physical Journal for April, May, and June, 1822.*)

[Read before the N. Y. Lyceum of Natural History, April, 1822.]

THIS mineral was discovered about two years ago, in the town of Ancram, in the state of New-York; a place remarkable for its iron works and lead mine. It was found on taking down one of the old walls of the furnace, erected in the year 1744. It attracted notice from its great weight; and although it resembled some common stone, it was supposed to be an ore, though of what metal was not conjectured. Several specimens having been sent to me for examination, I submitted them to analysis; and the result was altogether different from what the appearance of the mineral indicated. It proved to be a nearly pure oxyd of zinc, and an ore of that metal distinct from any hitherto described. This induced me to make further inquiries respecting the mineral, as it would be exceedingly valuable if found in sufficient quantity; but I have, as yet, been able to procure very little satisfactory information respecting it. Mr. Seth Hunt, who visited Ancram in October last, was informed by Mr. Thomas Ackers, manager of the lead mine, and Rob-

ert Patterson, Esq. of the iron works, that the ore was found built into the wall of the furnace, and that notwithstanding the repeated personal search of the latter gentleman, through the surrounding country, for the distance of several miles from the furnace, and making diligent inquiries of the ancient inhabitants, he had not been able to obtain any information that would direct him to the spot from whence it was taken. He has, however, every reason to believe that the ore was obtained within a few miles of the furnace, and, most probably, within a very short distance; but time, through whose lapse it was lost, may again bring it to light, and furnish to the fortunate discoverer, or proprietor, or to both, the means of wealth and independence. Since I received this information from Mr. Hunt, I have heard of the discovery of a considerable quantity of the mineral in the foundation of an old house near Ancram.

Description of the Mineral.

External characters.—All the specimens I have seen were tabular masses, possessing sometimes a distinct slaty structure; though they generally were composed of layers without a tendency to separate, giving the mineral a striped aspect, when viewed in a direction perpendicular to the direction of the strata. (layers? Ed.)

It is granular and compact.

Its colour is grayish green, or olive green.

It is perfectly opaque and the surface dull.

It is harder than calcareous spar, and is easily reduced to a powder, which is of a lighter green than the mass.

Specific gravity, 4.924.

Chemical characters.—Before the blowpipe it is infusible, but when the heat is intensely urged, the oxyd of zinc is volatilized, communicating a white colour to the flame. The powdered mineral dissolves instantaneously, and almost entirely without effervescence, in the stronger acids.

Analysis.

The following preliminary experiments were made to ascertain the nature of the mineral.

A. Some of it in fine powder was treated with nitric acid. It readily dissolved, leaving only a small quantity of a light black residue. The solution, on being filtered, was transparent and colourless, and yielded quadrangular prisms on evaporation. These had a caustic metallic taste, and were very soluble in water and alcohol. When the nitric solution was repeatedly boiled to dryness, and a small quantity of acid added at each operation, some pure oxyd of iron was separated. To the filtered liquor the following tests were applied :—

(a) The caustic alkalis produced a white precipitate, which was entirely re-dissolved by an excess of alkali.

(b) Prussiate of potash occasioned a white precipitate.

(c) Hydro-sulphuret of potash produced the same effect.

(d) Copper, iron, and other metallic rods immersed in the solution did not occasion any precipitation of metal.

(e) Muriatic acid did not disturb its transparency.

(f) Oxalic acid threw down a white precipitate.

B. There remaining no doubt that the principal metal of the ore was zinc, the black insoluble residue was next examined. It was not acted upon by acids, except strong nitric and sulphuric acids, which it appeared to decompose. When made into a ball with a little mucilage, and ignited, it burned almost entirely away without flame or vapour. Projected into melted nitre, it caused a violent deflagration. It was nearly pure *carbon*.

C. One hundred grains of the ore, in fine powder, dissolved immediately in diluted sulphuric acid ; leaving one grain of the black powder, which was ascertained in the preceding experiment to be carbon.

(a) The solution was clear and colourless. It afforded flat four-sided prisms on evaporation, having all the properties of sulphate of zinc. These were re-dissolved in water, and carbonate of potash added until precipitation ceased, and the liquor was boiled to ensure the complete decomposition of the metallic salt. The carbonates of zinc and iron were thus obtained.

(b) To separate the latter, the whole was re-dissolved in acetic acid, and afterwards boiled to dryness. The acetate of iron was decomposed, leaving the base in a state of per oxyd weighing 3.50 grains.

(c) It now remained to determine the quantity of oxyd of zinc, which was done as follows :—The solution obtained in the preceding experiment, after separating the iron, was precipitated by carbonate of potash. The carbonate of zinc thrown down was tested with ammonia, to be certain of the absence of manganese; but this alkali dissolved the whole of the precipitate, and proved it to consist of zinc alone. On evaporating the ammonia, and calcining the carbonate, 93.50 grains of oxyd of zinc were obtained.

The result of the analysis is :

Oxyd of zinc,	-	93.50
Oxyd of iron,	-	3.50
Carbon,	- -	1.00
		98.00
Loss,	- -	2.00
		100.00

The red oxyd of zinc of New-Jersey, discovered by Bruce, resembles our mineral in composition more than any other ore yet described. It however differs essentially in containing 12 per cent. of manganese, and in the absence of iron. Its external characters are altogether dissimilar. To distinguish it from Bruce's mineral, this may be called *green oxyd of zinc*; though I am aware that the name is objectionable, as there is but *one* oxyd of zinc, which is *white*.

It is much to be regretted that a mineral so interesting and valuable should not be better known. We hope the active search which is making for it will not be without success. It is by far the richest ore of zinc known; containing according to Thompson, 75.31 per cent. of metal. The red zinc ore of New-Jersey, beside the manganese which it contains, is always intimately mixed with more than half its weight of Franklinite, from which it is impossible to separate it by mechanical means; while the ore of Ancram is so pure that it can be used without any preparation, either for extracting the metal, or for the manufacture of brass.

ART. V.—*Observations and Geological Remarks on the Minerals of Patterson and the valley of Sparta, in New-Jersey.*
By 'THOMAS NUTTALL, F. L. S. London. (*From the New-York Medical and Physical Journal, for April, May, and June, 1822.*)

A CURSORY geological sketch, sufficient to excite a closer attention to the subject in those who follow the same route, may not perhaps be a superfluous introduction to the more immediate subject of the present communication. In my way, by the usual road, to Patterson, along the banks of the Passaic, little presents itself to the observation of the geologist, except the development of the Red sandstone formation, commencing at Bergen heights, four miles west of the city of New-York. In this ridge, which so immediately succeeds that of Hoboken and its *transition* serpentine, (for so I now consider it,) existed the famous copper mine of Mr. Schuyler, now abandoned, and which forms, in fact, only a small portion of a metalliferous bed, extending, at least, as far as the banks of the Rariton.

On approaching the town of Patterson, a scenery more diversified and romantic presents itself, and the surrounding cliffs and precipices, as well as that which produces the picturesque cataract of this place, consist of beds of trap, well characterized, and reposing on the red sandstone. This formation, which has been so carefully examined by my friend Judge Kinsey, of this place, is peculiarly interesting to the naturalist. The trap contains, as usual in its dispersed cavities, nodules of prehnite, of mezotype, cabasic, stilbite, agates, and, in one locality, fine crystals of datholite or siliceous borate of lime. Sometimes it passes into an amygdaloid, as in the Derbyshire toadstone, from which it can scarcely be distinguished, except by the rarer substances contained. In some of the amygdaloidal cavities lined with crystallized carbonate of lime, occasionally also occur small greenish crystals of the datholite; others are exclusively lined with druses of crystallized or lamellar chlorite, which indeed enters largely into the composition of the wacke or softer trap of this region. In Derbyshire this formation is overlaid by what is called the mountain limestone, one of the more ancient beds of the secondary formation; here the trap

and amygdaloid form the utmost summits of the hills, which in height approach to mountains. Its junction with the *red* sandstone is marked with some peculiar characters, highly imposing to those who feel inclined to favour the Plutonic theory. I must confess that at the point of union in these formations the trap is peculiarly ambiguous: it presents a regular porous structure; not, however, any thing like *pumice*; and many of the pores, if not *all*, seem dependent on the decomposable nature of the carbonate of lime, which still in the interior occupies those supposed pores. There are, moreover, in some few places, larger cavities, appearing somewhat glazed; and rugose masses, resembling slags; these are, however, appearances which ought to be weighed with caution, and are insufficient to demonstrate any thing like igneous origin. The porous quartz of Providence township, in Pennsylvania, and of West-Chester, in Delaware, connected with the greenstone formation, is far more imposing as a volcanic production; yet distinctly traceable into a reticular veined and compact jasper abundantly in place near to the Black Horse Tavern. This porous texture, perfectly original, is such as to render considerable masses of the mineral buoyant on water. But what are we to think of the serpentine, equally porous, in the same locality, and several others, (as near Dixon's farm, Wilmington, where it alternates with graphic granite,) which might be adduced, also gradually and distinctly passing into perfect compactness? If density alone is to be considered conclusive of aqueous origin, we must occasionally introduce a double system of formation into every class of rocks the globe exhibits, nor are even lavas less dense than other rocks, when cooled under considerable pressure.

In the ridge, about two miles west of Paterson, occur very perfect basaltic columns of small magnitude, (about a foot or eighteen inches in length, and from one to four inches in diameter,) presenting from four to six sides; blackish green and crystalline in the interior. This ridge throughout presents inclined beds perpendicularly divisible into columnar concretions as far as the banks of the Little Falls of the Passaic.

This basaltic rock forms the summit of every ridge, for about fifteen miles north-west, to Pompton, where it ceases, and is succeeded by grauwacke, grey, whitish, and liver

brown, containing occasionally pebbles of red and brown jasper. The affinity of this grauwacke with the red sandstone of Patterson is sufficiently obvious, not only from hand specimens, but from identity of relative situation, for they both underlay the trap. Casts of ammonites at Patterson* have been found in the larger pebbles, contiguous with the surface of the red sandstone formation, or near to the point where it enters into junction with the porous trap. In the lower portions of this formation, I believe, as yet, no organic remains have been discovered; and it is not unfrequently, when approaching to a slaty structure and argillaceous consistence, eminently metalliferous, as at Schuyler's copper mine, and that now working at Somerville, which presents masses of the ruby oxid, native copper, and minute portions of native silver.

Contiguous to the western declivity of the Pompton mountains, Judge Kinsey and Doctor Mead found pale green sahlite in abundant masses, connected with a beautiful smallish grained white carbonate of lime or marble, contiguous to a formation of diaphanous greenish yellow perfect serpentine, traversed, like that of Newburyport, with silky seams of amianthus.† Connected apparently with the greenstone formation, is a large rolled or rounded mass of Labrador felspar, sparingly mixed with hornblende, found by Judge Kinsey in the vicinity of the hills of Pompton.

After passing the Pompton mountains, a succession of the ridges of the Highlands present themselves, thickly strewn with rounded *debris*, so as to render even the valley lands difficult to cultivate. Passing the Warwick ridge, or Hamburgh mountains, we enter upon the valley of Sparta, where a white crystalline limestone and marble appear, occupying the valley, and rising westwardly into a low subsidiary ridge, about eight or nine miles in length, proceeding almost due north and south.

As the metalliferous deposits form here the most remarkable feature of the formation, we shall preface our examination of the minerals of Sparta, by a few remarks

* Collected by Judge Kinsey.

† The same mineral, with its usual associate, has been received from Philipstown, on the Hudson, by Professor Renwick, of Columbia College.

upon them. The first, or eastern bed, which at Franklin appears like a black mountain mass, at least thirty or forty feet wide, consists of an ore of iron, in common, scarcely at all magnetic, and with great propriety considered by Berthier as a new metalliferous combination entitled Frankinite, contains 66 per cent. of iron, 16 of zinc, and 17 of the red oxyd of manganese. On the supposed richness of this immense bed, the great furnace of Franklin was built; it was soon, however, discovered not only to be irreducible to metallic iron, but to obstruct the fusion of other better characterized ores in a notable degree. If employed in a quantity exceeding one tenth of the magnetic oxyd of iron with which it was economically mixed, the result was what the miners emphatically termed a *Salamander*, an alloy of iron, with the manganese, which resisted liquifaction, and crystallized even under the blast, so that all the metal was lost, the hearth demolished, and ten or twelve yoke of oxen necessary to drag away the paradoxical and useless metal produced.

This deceptive mineral, now abandoned for want of skill to reduce it, occasionally presents cavities lined with regular octahedral crystals, the sides of whose pyramids to each other as well as the angles of the common base measure by the reflecting goniometer, according to Doctor Torrey, angles of 108.15. At Franklin it is but sparingly intermingled with the red oxyd of zinc. In about two miles to the north, the Frankinite bed ceases to be any longer discoverable at the surface, but continues more or less distinct for five miles further to the southeast, or seven miles in its whole range. Three miles from Franklin furnace, at Stirling, another mountain mass or huge cliff of this formation presents itself; but here the red oxyd of zinc forms, as it were, a paste in which the crystals of Frankinite are thickly imbedded—in fact, a *metalliferous porphyry*! On the sides of the seams, abundance of octahedral crystals of Frankinite are often well developed, while those of the interior are commonly pseudomorphous. Numerous illiniations of the carbonate of zinc appear throughout the interior of the mass. This ore, merely pounded and mixed with copper, has been profitably employed, during the scarcity of the late war, for forming brass.

Often, within a few feet to the west of the Frankinite bed, appear others of well characterized magnetic oxyd of

iron, but always accompanied by hornblende rock. One of the most profitable beds of iron ore was discovered on the very spot where the furnace stands; this highly magnetic oxyd so much esteemed, is very intimately blended with plumbago, so as at first glance to resemble the siderographite of Doctor Torrey. In the latter, however, the iron is perfectly metallic; in this a protoxyd.

Among the more curious accompaniments of this metaliferous formation is the brownish yellow garnet, analyzed by Vanquelin, who found it entirely soluble in muriatic acid, which not only takes up the silex contained, but also the manganese, in consequence of its existing in the mineral at the minimum, of oxydation. The same substance has now also recently been analyzed by Mr. Seybert. It here forms a bed or vein six or more feet wide, and when occasionally in contact with the carbonate of lime exhibits imperfect dodecahedrons of a lustre and colour almost similar to idocrase.

Contiguous to the great bed of Franklinite, at Franklin, is interposed, as it were, in the crystalline carbonate of lime, which prevails to the east, a ledge of imperfect sienitic granite,* scarcely presenting any thing more than gray crystalline rocks of a binary combination of quartz and felspar. In these rocks occur beautiful opaque blackish-brown masses of garnet, of a high resinous lustre, and crystallized on the surface; it agrees in every respect, but the unimportant one of direct colour, with the melanite of Frascati, near Vesuvius; it is accompanied by a laminated epidote almost similar in appearance with the loböite, or idocrase magnesifere of Berzelius.

Near the same locality there is a vein or two contiguous to the junction of the sienitic granite and carbonate of lime, consisting almost exclusively of a nearly white and compact massive, or minutely lamellar augite, in some parts intimately blended with specks of violet, granular felspar, resembling petrosilex; also sphene, brown garnet, dark green granular augite, like the coccolite of Lake Champlain; something of nearly the same colour, and infusible, which we suppose may prove the Gahnite, occa-

* According to Dr. Macculloch's sagacious definition in his geology of Glen Tilt, being here or there, a mere modification of granite, and totally unconnected with the genuine sienite allied to greenstone.

sionally in octahedrons, and minute pale bluish green prismatic and translucent crystals, which are probably phosphate of lime. These veins, which stand up in crests from the more decomposable carbonate of lime in which they are imbedded, present also on the surface druses of augite crystals, and some of the accompanying minerals.

A little distance from this vein, there is another, apparently much broader in its dimensions, being a mixture in the mass, more or less intimate so as to be often minutely granular, of green felspar of a colour from pale olive to that of carbonate of copper, black hornblende, gray quartz, whitish augite, mica, and occasionally sphene or silico-calcareous oxyd of titanium. In the cavities of this vein, and often considerably immersed below the surface, are, in considerable abundance, bluish green octahedrons of the spinelle, sometimes presenting truncations on the edges, but more commonly on the common base, and occasionally exhibiting cuneiform summits. The angle of coincidence of its faces measured on the reflecting goniometer, by my friend Dr. Torrey, are 109.23; it likewise scratches quartz, is infusible, and scarcely becomes paler by heat. The crystals are in size from the bigness of a pin's head to half an inch in length, the larger of course, darker, and mostly breaking into splintery fragments, have internally a more or less perfectly conchoidal fracture, and high resinous lustre; most of the crystals, when slightly rubbed, indeed, present the brilliance of polished steel; the smaller crystals are also so far translucent as to reflect a splendid coloured reflection, little short of that of the diamond. In these cavities they are commonly associated with augite crystals, quartz, hornblende, green felspar, crystals of phosphate of lime, and in two or three of my specimens imbedded mica, arsenical pyrites, and traces of galena. The affinity which these specimens bear to those of Vesuvius, containing Ceylanite is striking to astonishment, and I have even seen the brucite or condrodite, like that of Sparta, from Vesuvius.* No vestige of volcanic fires, more than the

* In the cabinet of Mr. Wagner, junior, Philadelphia. Since writing the above, my friend Mr. Bowen, subjected another fragment of the supposed condrodite of Vesuvius which belongs to the cabinet at New-Haven, to examination, and found it to agree in the general results, with the analysis of that mineral recently published in Europe. It is now also found in one or two other localities in the United States besides Sparta.

pseudo productions of the Missouri, have yet, however, been discovered in the territories of the United States.

The CONDRODITE, or BRUCITE, almost peculiar to Sparta, discovered likewise by the celebrated Berzelius, in Finland, accompanied by gray Spinelle, is (according to an unpublished analysis which I made in 1820,) a silicate of magnesia with an *accidental* portion of fluoric acid and iron. The same result has been obtained by Dr. Torrey, from whom I copy the following description of its crystallization. It occurs occasionally in small four-sided prisms, (of a paler colour than the amorphous masses,) with rhombic bases of 124° and 56° truncated on the acute lateral edges by planes which form with the contiguous sides of the prism angles of 122° and 114° . The prism is terminated by dihedral summits whose faces meet under an obtuse angle, and correspond to the acute, truncated edges of the prism. The edges of the summits are oblique to the axis of the prism, but not parallel to each other; or they may be said to be alternately oblique at each extremity."

Haüy, also, by cleavage, had obtained from it a rhomboidal prism; and Berzelius, who then compared it analytically with his condrodite, concluded it to be identic. The former, with his usual sagacity, referred it to his peridot; as it does not indeed very materially differ in composition from olivin or amorphous chrysolite: still the crystallization proves it to be a very distinct species. It is of a bright brownish yellow, bordering on orange, disseminated in masses commonly about the size of a hazle nut, exhibiting more or less of the rhombic form, throughout a white and foliated lime-stone, generally containing scattered hexagonal laminæ of plumbago, and more rarely, bluish pellucid crystals of phosphate of lime. It is imperfectly lamellar in one direction, splintery in the other, with a glassy or almost resinous lustre, the fragments either translucent or nearly opaque, and sufficiently hard to scratch glass. Before the blowpipe it is infusible, but with borax forms a glass, though not very readily. Its gravity is a small fraction above 3.

Throughout the valley of Sparta the condrodite is by no means uncommon, but variable in its appearance. The finest and clearest masses are obtained at the town of Sparta. Though abundant at Franklin, it is here opaque and of a deeper tinge of colour. It occurs thickly dissemina-

ted often towards the base of the calcareous beds, and contiguous to foreign infiltrations or veins. A mile south of Franklin furnace it is also seen imbedded in a gray massive augite, accompanied by mica and fluat of lime: the blue fluat here also forms slender illinitions in the marble. Near to this spot tremolite and small imbedded crystals of white augite? and of actynolite occur: short crystals of augite, almost black, like those of volcanic rocks are also now and then visible; a beautiful apple green felspar as indicated by the goniometer, occurs imbedded in the crystalline carbonate of lime, accompanied by perfect crystals of mica, and hexagonal plates of plumbago; this felspar is unusually soft, and almost as fusible as hornblende. A very brilliant pale green hornblende, passing into actynolite is often found massive and in implicated crystalline confused crusts over the surface of the calcareous beds.

This hornblende considerably resembles the *supposed* hypersthene of Delaware, recently analyzed by Mr. Seybert, who considered it as hornblende; it however gives the goniometrical measurement of hornblende, while the Delaware mineral, according to the observation of Dr. Torrey, gives by cleavage, a prism which is nearly rectangular, or with angles of 89° and 91° .

It forms, therefore, a new species, which we propose to name *MACLURITE*, in honour of him who has done so much for American geology, and natural science in general.

According to Mr. Seybert, it contains in the 100 parts: water 1,266; silic 52,166; deutoxide of iron 10,733; manganese a trace; alumine 4; lime 20; magnesia 11,333. From which an obvious affinity to augite presents itself, as it actually differs less in chemical composition from augite, than the two analyses of augite, given in Cleaveland, differ from each other; it fuses also with difficulty; but as the crystalline structure is essentially distinct, it must necessarily be considered as a species destitute of every affinity with hornblende, from which at the same time it is scarcely distinguishable, except by the cleavage. In degree of fusibility, in its hardness, colour, laminar texture, metallic brilliancy, and specific gravity, it is scarcely to be distinguished from the green stone.

In another neighbouring locality, enormous green crystals of augite are found, some at least an inch and a half in diameter, presenting hexaedral or octahedral prisms, with almost equal faces, and terminated by oblique tetrahedral pyramids.

These are accompanied, near the junction of the granite and crystalline carbonate of lime, with large crystals of felspar, scapolite, or wernerite, and something which borders on spodumene. On the margin of the mill pond at the furnace, where some repair was making, a vein of arsenical pyrite, mixed with others resembling the sulphuret of cobalt or nickel, with a substance somewhat like blende, was found, and likewise accompanied by the condrodite.

In another limestone abounding with sphene, dark coloured granules, and minute crystals of augite, there are numerous and generally amorphous, dull grayish blue nodules imbedded, which by goniometrical measurement indicate some variety of fluato. It is nearly quite opaque, but fusible into a white enamel; both externally and internally dull, and minutely splintery or granular in the fracture. It is commonly so much penetrated by the carbonate of lime and titanium oxyd as seldom to present any angle which can be measured. Its hardness is about that of common fluor. It is very feebly acted upon by acids in the cold, but still slowly gives out minute bubbles. When examined it will probably prove the argillaceous fluato of lime, of which I have never seen specimens.

The crystalline calcareous rock, which here alternates with granitines of felspar and quartz, or with beds of sienitic granite, (near to Doctor Fowler's house, the proprietor of the Franklin works,) disappears, and a confluent grauwacke, almost porphyritic, and contemporaneous apparently with the other formations, appears directly overlaid by a bed of leaden minutely granular, *secondary* limestone, containing organic remains of the usual shells and corallines, and layers of blackish hornstone or petrosilex. This rock, as well as the grauwacke *beneath*, presents disseminated crystals of blue fluato of lime. In the limestone the cavities are sometimes very numerous, and lined both with pseudomorphous masses and cubes of blue and white fluato and quartz crystals.

Thus we have here before us, as at lake Champlain, the novel and interesting spectacle of an union of every class of rocks, but *passing* decidedly *into each other* as if almost *contemporaneous*! If they are not contemporaneous, how do they happen to penetrate each other by veins? Why do they present similar mineral substances; similar organic remains; why do the same relicks of plants occur over the

anthracite of Rhode-Island, (which is occasionally penetrated even by seams of asbestos,) as over the bituminous coal-fields of Pittsburg and Richmond? Why are the beds of coal, at Richmond in Virginia, penetrated by veins of granite?

Lastly, why are the same organic remains found in the *alluvial* limestone of Carolina and Georgia, as those of the Great Calcareous Platform west of the Alleghany mountains? Are, in fact, those supposed epochs of time, believed to have intervened between the production of strata any thing more than an imaginary distinction of formations really allied, and as strictly dependent on each other, as the members of the same formation? The grauwacke and red sand-stone, we perceive, contain organic remains; the grauwacke imperceptibly blends with the granitines, sienites, and greenstones of the Highlands. The hornblende rock and its metalliferous deposits unquestionably pass into gneiss; gneiss is foliated granite. Where then are we to seek for permanent distinctions? What is primitive—what is transition—what secondary—but the alluvions of rivers and of seas? Of what importance is the inclination of strata, as the uppermost must necessarily be inclined at a decreasing angle? Nor are examples wanting of a conformable stratification of the secondary with the oldest or the primitive;† and although the rocks referred to the primitive formation, more frequently present vertical or highly inclined planes of stratification, yet, as Mr. Greenough remarks, it is also true, that every rock in different parts of its course exhibits planes both vertically and horizontally inclined.

I am, I must confess, attached to those plausible distinctions of things which tend so importantly to facilitate information and promote instruction; yet I would not wish to submit to the shackles of an imaginary system, or prostrate understanding at the shrine of an ambitious theory. Nature yet presents a wide field for contemplation; there are mysteries yet unravelled—prejudices which blind—systems which for the present impose, and which must ultimately vanish before the test of truth.

* The pentrenite of Mr. Say, or asterial fossil of Parkinson, is found twelve or fourteen miles from Savannah, in the limestone, as well as in the vicinity of Huntsville in Tennessee.

† See Dr. MacCulloch's Mineralogy of the Isle of Sky, Trans. Geolog. Soc. Vol. 3, pp. 50, 51.

‡ Greenough's Geology, p. 40.

ART. VI.—*Notice of Crystallized Steatite—Ores of Iron and Manganese, &c.* by PROFESSOR CHESTER DEWEY.

1. *Crystallized Steatite.*

I HAVE lately visited the locality of this mineral. It is found in that great bed of serpentine in Middlefield, county of Hampshire. The rocks about it are all primitive. The crystals of steatite have yet been found only in one place, between two layers of serpentine. The serpentine occurs in immense masses, overlaying each other in strata or blocks separated by seams. Between two of these layers of serpentine is steatite two or three inches thick, the upper surface of which is covered with these crystals. The crystals are however separated from the superabundant mass of serpentine by a thin layer of asbestos. The asbestos is pressed down entirely close upon the crystals, and, if it be carefully removed from them, shows the form of the heads of the crystals. We have only to see the position of the crystals of steatite to be satisfied that they cannot be *pseudomorphous*. This is a strong reason, additional to those given, page 275, Vol. IV. of this Journal, in support of the opinion that they are *true* crystals. There is occasionally found among these crystals, a crystal of oxyd of iron, covered over with the steatite, but of a form entirely different from the crystals of steatite. The appearance of the whole is that when the crystals were formed, the entire mass was in a soft and yielding state. The crystals, which were easy to obtain, have already been removed, and, to obtain more, it will be necessary to remove, in part, the mass of serpentine above them. It is possible that analysis may prove these crystals not to be steatite. That they belong to the steatite family, there can be no doubt; and the general characters direct to the opinion that they are only a rare and interesting variety of steatite.

2. *Ores of Iron and Manganese in Bennington, Vt.*

The principal bed of the ore lies three miles east of the village of Bennington, very near the furnace at which it is wrought. The ore of manganese is found at the same bed, but entirely separate from the iron ore. The location of

the ore bed is rather singular. It lies at the southern side of a hill, which is connected with a high mountain running in a northerly direction. This mountain has been burnt over until the trees and smaller vegetables for a considerable distance from the summit have been entirely destroyed, and it appears, when viewed from the village of Bennington as a huge mass of white limestone or of quartz. Specimens of the rock were shown me at the furnace. They were magnesian limestone. The hill, which forms the southern part of this mountain, and at whose foot runs a small river, rising in the mountains still farther east, does not exhibit any rock near the mine. The valley on both sides of the river is covered with rounded masses of granular quartz. The bed of ore lies in the side of this hill, in the loose sandy soil or earth which prevails here. Small rounded masses of the quartz are found in the earth over the mine. The bed of iron, where the ore has been dug, is elevated but a few feet above the level of the river. The hill rises pretty rapidly sixty or eighty feet, but the bed of ore does not rise as much, so that at the distance of about thirty or forty feet from the southern part of the bed which has been explored, the iron ore is about fifty feet under the surface of the hill.

The ore of manganese was discovered a little lower down than the iron, and is found to ascend, as the bed is explored, in the same manner as the iron ore. It is always separated from the iron ore by an earthy portion, often very thin, and were there not other distinguishing characters, is not liable to be confounded with the ores of iron.

The bed has been explored for six or eight rods in width, and the iron ore is known to extend along the lower part of the hill and but a foot below the surface, more than twenty rods in width. Its extent up the hill and its depth are unknown; but the ore seems to be inexhaustible. Both kinds of ore are dug with great ease, and a stream of water is turned from the hill into the mine, for the purpose of working the ore. The late proprietor of the ore-bed and furnace, and the proprietor of the manganese, Mr. Trenner, very politely accompanied me in my visit to the place, and afforded me every facility in the examination, while he augmented the pleasure of the visit by his hospitality and readiness to answer all the questions I wished to ask.

The iron ore is the common brown hematite, with some argillaceous oxyd of iron. Yellow ochre is also found in considerable quantity. The ore much resembles that of the mine in Salisbury, Con.; but the stalactitical form is rare here and not so beautiful.

The ore of Manganese is the common black oxyd, generally compact, sometimes mammillary or botryoidal. The excellence of this ore is well known. Many tons are annually carried to market for the purpose of bleaching. The price at Boston varies from forty to fifty dollars a ton. It is also coming into use, as a substitute for red lead, in the glazing of common earthen ware.

One specimen of fluete of lime, crystallized and very beautiful, has been found with the manganese.

Similar iron ore is also found in the north-western part of Bennington. It occurs in beds of one or two inches to six inches in depth, in a loose soil lying upon limestone rocks. Those beds are of small extent, and probably are not connected with any bed like that described above.

It has been remarked that the great bed of ore is not immediately connected with any rocks. It seems, however, to be associated with limestone rocks, and the whole to lie between two strata of mica slate. It lies in the same range with the ore of Salisbury, Con. and has the same range of mica slate lying on both sides of it. The same kind of ore is found in scattered pieces on the surface in several of the towns in this County, and in Lenox it occurs in abundance.

ART. VII.—*Notice of a Mineralized Tree—Rocking Stone, &c. by Professor JACOB GREEN.*

1. *Mineralized Tree, &c. &c.*

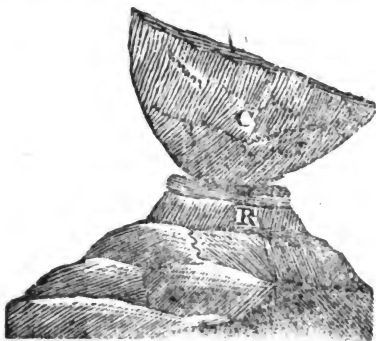
ABOUT half a mile from the village of Chitteningo, in Sullivan County, (New-York) a fossil or mineralized tree was some years ago discovered. It lies at the base of the Conasewago mountains, within a few yards of a branch of the Erie canal, which runs up to the village. The tree appears to have been blown down and broken off—there are eight or ten feet of the stump remaining, with some part of the large end near the root—the stump is about three feet

in diameter—the bark—the fibrous texture of the wood and two or three knots are very obvious—there is a substance very much resembling veins disseminated through what seems to have once been the sap vessels of the tree, and from this circumstance, I am induced to believe that it belonged to the Genus *Pinus*, although others have supposed it a *Juglans*. The lower part of the root is imbedded in the soil, where it probably once grew. Vast quantities of mineralized wood both in small and large masses are scattered in all directions around this stump—these fragments from their loose porous texture, seem to have been petrified, after the wood began to decay. Indeed so numerous are these fragments that almost every stone in this vicinity appears to have been once a living plant. The traveller who feels interested in mineralogical pursuits, will find Chitteningo well worthy of his attention. Besides the tree just mentioned, hydraulic lime-stone and beautiful lamellar gypsum are found in this neighbourhood; and about two miles from the village, a spring of water, so highly charged with sulphur, that branches of trees, thrown into it, soon becomes incrustated with that mineral.

2. Rocking Stone.

Moveable rocks, or masses of stone so nicely balanced as to be set in motion by a very small force, have excited the attention of both ancient and modern writers. As far as my information extends, there is but one of these famous rocks, noticed as being found in the United States—this is in Morse's *Geography*. When mentioning the curiosities in New-Hampshire, the author makes the following statement: "In the town of Durham, is a rock computed to weigh sixty or seventy tons. It lies so exactly poised on another rock as to be easily moved with one finger. It is on the top of a hill and appears to be natural." Putnam's rock, mentioned in the last number of your *Journal*, seems also to have been of this description. This rocking stone which I visited last spring, is situated on the farm of Mrs. McCabbe in Phillips Town, Putnam County, New-York. The West-Chester and Dutchess turnpike road, which runs a north east direction from the village of Peekskill to the town of Kent, lies about one mile to the east of this rock. The person who wishes to visit it must travel eight miles

on this road from the village of Peekskill, and then ascend a very high and steep hill on the left hand, near the top of which the rock may be seen. The moveable stone is about thirty-one feet in circumference, and five feet through in the thickest part—it is of granite, the mica bed so stratified as to present somewhat the appearance of gneiss, and it stands or is supported on a base or pedestal of the same mineral. A better idea will be formed of the figure and position of this rock from the rough sketch which accompanies this, than from any verbal description. The under rock or pedestal (R) is about one foot and a half high, and is almost flat on its upper surface. The rolling rock (C) rests on this plane. Although it cannot be shaken as easily as the wonderful rock in Asia mentioned by Pliny—or as the Gygonian stone, which trembled on being “struck with the stalk of an Asphodel,” it can however be rolled a little by the hand, and with a small lever it can be moved with great ease;—notwithstanding this, six men with crow-



bars have been unable to roll it down from its pedestal. Large masses of steatite are scattered around—good specimens of Asbestos, may also be obtained at a short distance. I found some very pretty specimens of blue quartz in the blocks of granite, which form the fence along the road. On the west of the rocking stone, about half a mile, there is a lake three miles long and half a mile wide—a sheet of water of much magnitude is not frequently met with on such an elevation.

3. *Miscellaneous.*

The minerals in the immediate neighbourhood of Princeton, are few, and possess but very little interest. Cubical crystals of iron Pyrites are to be found along the margin of Stony Brook, imbedded in shale. Crystallized quartz, is not uncommon. The crystals are generally imperfect, and not very transparent.

A bed of Argillite, very proper for building stone, crosses the road at the north end of the town—it makes a considerable dip. In this bed, I have been informed that wavellite occurs, but I have in vain searched for it.

Specimens of *recently* petrified wood are sometimes met with lying on the surface. In my cabinet there is a piece, which appears once to have been the lower end of a chestnut post, used for fencing—the exterior of it is black, as though it had been carbonized or charred. I have also seen a mineralized *chip*, with the marks of an axe very apparent upon it—the petrifying matter is silix.

A very excellent bed of siliceous sand, used for mortar, is near the road side, south east of the village. There are other beds of sand in the vicinity. Silix in large pebbles is not uncommon. Yellow earth is found on the side of a hill in our neighbourhood—it is used for painting carriages—and is by artists considered as a *very good* substitute for the tena de Sienna—with Prussian blue it forms a very delicate olive yellow colour.

ART. VIII.—*Miscellaneous Localities of Minerals.*—Editor.

Sulphat of Barytes.—Mores Mills, Berlin, Kensington parish, foliated, pure white, translucent, brittle,—jet and galena imbedded.

Fluor Spar of New-Stratford.—The American Chlorophane, containing imbedded a well defined brilliant crystal of beryl, half an inch in diameter and protruding one inch and a half from the fluor.

Porous decomposed trap filled with numerous white crystals too minute to be distinctly observed, but probably *stilbite*. Talcot Mountain, ten miles west of Hartford.

Iron Pyrites.—Having every appearance of a petrification of the body and limbs of a frog. Trumbull County, Ohio.

Fluor Spar.—Black with a resinous lustre, by transmitted light, it appears of a topaz yellow, or like smoky quartz; in the cavities, the crystals are white and transparent. Huron County, Ohio.

Sulphat of Barytes.—White foliated, New-Stratford, Dr. Nathan Smith.

Calcareous Petrification of Wood.—Canasarago Creek, New-York. A similar specimen from Chitteningo, a part of a very large tree. Hon. Mr. Storrs, M. C.

Gray Wacke.—With a fine grain, being part of the rock on which Capt. James Cook fell at Owyhee. Mr. Smith of the Cornwallis frigate, Royal Navy of Great-Britain.

Specimens from Prof. F. Hall.

White compact Marble.—Highly translucent, very handsome.

Plumbago, in grey crystallized limestone.

Micaceous Iron, very beautiful, New-Fane.

Magnetic pyrites.—Copperas is made from it at Shrewsbury, Vermont.

Black Tourmalin in Quartz.—Dummerston, very handsome.

Diallage in serpentine Rocks, near New-Haven. This mineral is well characterized.

Galena, near Lexington, Rockbridge County, Virginia. It is in small plates, almost fine grained.

Plumbago.—Cornwall, Conn.—Dr. Cornwell.

From Dr. H. H. Hayden.

Brown tourmalin, nine miles west of Baltimore.

Supposed crystallized Magnesia.

Zeolite—both radiated, (Mesotype) and cubic, (chabasie) near Baltimore.

Ligniform Steatite.—Nine miles from Baltimore.

Shells cemented by the red hæmatite, Winchester, Virginia.

Steatite, coloured of a beautiful lilac (by chrome ?) bare-hills, near Baltimore.

Beautiful ferruginous yellow crystallized quartz,—Blue Edge or South Mountain.

Lamellar Quartz.—Nine miles from Baltimore.

Handsome Porphyry.—Nicholson's Gap, Blue Ridge, Pennsylvania, crystals red and distinct.

Broad foliated Felspar.—Flesh-red, very fine, nine miles from Baltimore.

Brown hematite.—Thirteen miles from Baltimore, York Road.

Quartz.—Elegantly stained blue and green, by carbonat of copper, Blue Ridge.

Bitterspath.—Very handsome, forming a vein in the compact limestone, nine miles from Baltimore.

Apatite.—Red crystals in quartz and felspar.

Analcime and Mesotype.

Fine black tourmalin in veins in gneiss.

Elegant brown tourmalins, twenty miles from Baltimore.

Mass of Adularia in crystals with chlorite.—Found in a brook near Baltimore, the vein not discovered.

Most beautiful Epidote.—With green and other shades of copper scattered in quartz; the blue is prevalent, abundant in the Blue Ridge.

Quartz and epidote, with green carbonat and red oxid of copper and native copper, Blue Ridge, abundant.

Other Localities.

Petrified Wood, almost black, Stafford County, Virginia.

Arragonite, beautifully crystalized, Bermuda.

Do. in geodes and cavities, forming the cement of a siliceous pudding stone, near Schenectady.—Dr. Murdock.

Iron Sand is found in great quantities on Block-Island, as appears by a M. S. letter of Peter Oliver to Dr. Elliot, Dec. 14, 1761.

Amber was found near the Delaware, in West-Jersey, in detached pieces, near one pound weight, yellowish, nearly transparent, and fitted to make good cane head. Bartram's M. S. letter to Dr. Elliot, Dec. 2, 1762.

ART. IX.—*Descriptive Catalogue of Rocks and Minerals collected in N. Carolina, and forwarded to the American Geological Society, by DENISON OLMSTED, M. A. G. S. Professor of Chemistry, &c. in the College of N. Carolina, April, 1822.*

No. 1. *Sulphate of Barytes*; exhibiting the foliate structure and glistening lustre of the mineral. (handsome.)

2. The same, in mass, of a cubical figure, with quartz on one side. (very handsome.)

3. The same, exhibiting its lustre when so broken as to present the edges of the laminæ distinctly.

These three specimens were obtained at the same place, near Hillsborough, where an abundant formation of the mineral has lately been discovered. It occurs associated with quartz, with which, as in Nos. 1. and 2., it is frequently united in the same mass, the quartz adhering to its sides, and shooting perfect crystals through its mass, as in No. 1. An excavation of only four feet in depth and five or six in length has yet been made; but this has disclosed the Barytes, in cubical and nodular pieces from three to six inches in diameter, lying side by side, and running into crystallized quartz on the right and left. The region around is strewn with fragments of quartz, variously figured, and everywhere shewing a strong tendency towards crystallization, and often actually forming congeries of very regular prisms. Masses of the Barytes of equal purity with No. 2. and six inches in diameter, were taken from the lowest layer, and the size, it was said, regularly increased with the depth. The prevailing rocks of the vicinity are chlorite and clay slates. (very handsome, delicate blue.)

4. *Mica*, from Henry Co. Virginia. The superb lustre and fine shades of colour which this specimen exhibits were common to a great number of pieces brought to me at the same time.

They were furnished by a person who evidently had employed very little pains or skill in selecting the specimens. He reported that those of this kind were exceedingly common. The small piece is added to shew the splendid colours exhibited by refraction from minute veins in a thin lamina. An effulgence of vivid green, blue, and red, displayed at a certain angle, will be particularly observed.

5. *Fine white clay*, from Stokes Co.—An extensive bed of it is said to exist.

6. *Compact carbonate of lime*, of a jetty black. Would not this furnish a marble suitable for pavements?—Found in Tennessee.

7. *Mica Slate*, colour, emerald green, from the western part of this state, (N. Car.) near the Blue Ridge.

8. *An Ore of Manganese*, (black oxid,) from Surry Co.—Reported to exist in great abundance.

9. *Carbonate of Lime*, (grey compact limestone,) from the alluvial country—forms an extensive bed on the lower parts of the Cape Fear, where it is burnt for lime.

10*—14. Varieties of the sandstone, (constituting the independent coal formation?) of this state. (Amer. Journal, Vol. I.) This formation commences not far from the Roanoke, in the county of Person, and passing through the counties of Wake, Orange, Chatham, and Moore, probably terminates at the Yadkin. Its length cannot be less than one hundred miles, and its average breadth not less than from eight to twelve miles. Indications of coal are reported of various places throughout this whole range; and a bed of coal highly bituminous and combustible, has been opened near Deep River, at the southern extremity of the county of Chatham. The pit has been dug only ten feet deep and 20 in diameter. Wagon loads are occasionally carried away by the blacksmiths; but wood and charcoal being very cheap in the vicinity, the coal, although easily obtained, is not much sought for. At the surface of the ground the coal appears only in a stratum of six inches; but at the depth of ten feet it has increased so much as to be two feet thick. Next to the coal is a black, greasy, bituminous shale, of a conchoidal fracture. The remainder of the pit is occupied by clay slate, divided into very thin plates, which fall to pieces when removed.†

The pit being full of water when I visited it, I had no opportunity to ascertain the dip of the strata.

* I am not quite certain whether the sandstone formation terminates on the N. at the Neuse or the Roanoke.

† I regret that I cannot transmit specimens of this coal—I had several pieces, some of which were iridescent, but have used them all in chemical experiments.

This formation affords very numerous varieties of sandstone, (of which those transmitted are but a small part,) including many kinds suitable for building, exhibiting various shades of red, gray and yellow. In several places they are quarried for the purposes of architecture, for grindstones, for whetstones, and, even (when they contain pebbles) for millstones. On its western line the sandstone passes at the foot of the hill on which the college of N. Carolina is built; and fine red and gray sandstone, every way suitable for building, may be obtained within less than two miles of the college.

15. *Sandstone*, of the alluvial country, from Waynesborough. A similar kind is used in Fayetteville for building.

16. *Granite passing into Gneiss*, from Raleigh. This ridge of granite, which extends at least 50 miles, through the counties of Warren, Franklin and Wake, and probably much farther, affords abundant and most excellent materials for building. Lying a little elevated above the neighbouring grounds it is easily quarried; and the universal diffusion of the mica and fineness of the other ingredients give it a looseness of texture which render it capable of being as easily hewn as common sandstone. Its qualities are finely displayed in the late additions to the State House at Raleigh. On the west of Raleigh three miles, it passes decidedly into Gneiss which appears capable of affording the largest slabs; but no quarry of it has yet been opened.

17. *Granite*, from Person Co.—Granites of this description, containing a large share of felspar in a state of decomposition, and affording materials for porcelain clay, are very common in this upper country; and the complexion of the other forms of granite is very various, including coarse and fine-grained, red and grey of various shades, and all degrees of hardness.

18. *Micaceous*, or talcose slate, full of small veins and crystals of pyrites, from Wake. See No. 86.

19. *Talc*, with radiated crystals, from Rockingham.

20. *Indurated Talc*, from Wake, susceptible of a good polish and used for ornamental parts in architecture—both the pieces are, in fact, very fine soap stones.

Talc and soapstone, of various aspects and qualities, appear in every county of the primitive region in this state. I have already ascertained most abundant formations of one or both of these minerals in the counties of Wake, Gran-

ville, Person, Orange, Chatham, Rockingham, Randolph, and Stokes; in all which places, it is employed extensively for various useful purposes in building. Remains of Indian utensils, formed of these substances, are also very common.

21. *Flint*, (Hornstone,) associated with compact earthy limestone, from Wake—occurs in the sandstone formation. Small pieces of carbonate of lime, usually of dark brown colour, are found in various parts of this formation; but no bed has yet been discovered, though it is a great desideratum, lime being transported from Fayetteville to this place, 70 miles. Mr. Maclure (Obs. on the Geology of the U. States,) does not encourage us to expect an extensive bed of limestone in the sandstone formation.

22. *Mica slate*, constituting the bed of the plumbago of Wake. This singular rock, which sometimes appears of a cherry red, as in this specimen, and sometimes of a glistening pure white, as in No. 85, and sometimes of the two blended together, lies between the gneiss mentioned under No. 16, on the east, and the sandstone on the west, being covered by the latter on its western declivity. As it appears in the walls of the mine of plumbago, it is seamed horizontally, by which means it is easily obtained in large masses which are used in the neighbouring county for underpinning and steps, though it is evidently too fissile and absorbent to be durable as a building stone. It however, as might be expected, is said to be a most excellent *fire stone*.

23. *Chlorite interspersed with crystals of hornblende*, from Wake.—Occurs in the vicinity of No. 22, and is obtained in sufficient quantity for chimnies.

24. *Marly limestone of Wayne Co.*, in the alluvial country, a little east of the primitive, supposed to be the kind referred to by Mr. Maclure, (Obs. on the Geol. of the U. S. p. 34.)

25. *Primitive granular limestone of Stokes Co.* This county, situated in the north-western part of the state, I have not yet had opportunity to visit; but from the number of specimens sent from there (several of which are among this collection,*) and from their extensive formations of iron, limestone, clay, soapstone, &c. I am induced to believe that it offers an inviting field to the mineralogist. This lime-

* Viz, Nos. 5, 26, 27, 28, 29, 45, 50, 51, 56, 70, 76, 77, 79.

stone usually exhibits some shade of bluish white, (No. 51.) it is sometimes mixed with magnetic pyrites (56); and is frequently traversed by veins of calcareous spar containing fibrous actynolite. (56)

26, 27, 28, and 29. *Chalcedony, Jasper, Agate, Red Jasper, and Yellow Jasper, of Stokes.* These siliceous minerals, including No. 79, and numerous varieties of the same, are found in one field, scattered over the surface of the ground. Pieces of coarse chalcedony, five inches in diameter, were among the number.

30—44. *Varieties of Quartz*, intended to illustrate the following remarks.—A singular deposit of quartz is scattered over this region, covering a tract of country in a narrow band from N. E. to S. W. not less than 50 miles long, passing through the counties of Granville, Orange, and Chatham, and embracing almost every variety of this mineral mentioned in mineralogical works. Indeed, nearly all those in this collection were obtained in one field, six miles west of this village. Besides several other foreign substances, incrusting or penetrating the quartz, fragments similar to No. 41, associated with a large proportion of specular oxide of iron, form a pretty regular line from Hillsborough southward into the county of Chatham, more than twenty miles.

45. *Mica Slate*, from the Saura Town mountains, in Stokes. At the base of the mountain are found heaps of yellow micaceous sand, resembling pyrites, and often deluding the inhabitants with an impression that it contains gold.

46. *Tortuous Mica Slate*, from the western part of S. Carolina.

47—49. *Petrified Wood*—No. 47, is from Fayetteville; 48 from the banks of the Neuse in Wayne Co.; and 49 from the vicinity of this village. In each of these places, it occurs in very numerous fragments, usually scattered over sandy plains. It is highly siliceous, and frequently exhibits veins of chalcedony. No. 49 is found over red sandstone. The banks of the Neuse in many parts of its course are strewed with pieces like No. 48.

50. *Actynolite*, associated with calcareous spar, which traverses the Stokes limestone in veins.

51. *Blue Limestone*, of Stokes.

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52. *Sulphuret of Iron*, (capillary pyrites? Jameson 3,210.) From the banks of the Neuse near Waynesborough, found imbedded in an earth that is full of copperas, which effloresces on its surface, and is manufactured by the inhabitants for use. This pyrites also decomposes on the surface of the ground and forms copperas.

53. *Porous Basalt?* from the vicinity of the natural wall [Basaltic Dyke] in Rowan. Is it similar to the Dutch *Terras* (Aikin's Dic. Art. Cement,) and would it answer for hydraulic mortar?

54. *Cubes of Sulphuret of Iron*, exceedingly common in this region. On the Haw River they occur in such abundance that an individual, it is said, supposing them to be valuable, collected several bushels of them. They are frequently striated on the sides, the striæ of two contiguous sides being at right angles.

55. *Epidote* in quartz, found in a small vein crossing clay slate.

56. *Stokes Limestone with Magnetic Pyrites*. When the iron is disseminated through the mass, (as is frequently the case,) would not this lime serve as a water cement?

57. *Pyrites*, same as 52, added to shew their sonorous properties when struck together.

58. Light coloured hornstone in stripes passing into flint.

59. *Native Iron*, fragment of a specimen from Randolph Co. weighing two pounds Avoirdupois. It exhibits the following characters:

Nodular, having one side distinctly plated.

Hard, assuming under the file the lustre of steel.

Highly magnetic.

Specific gravity, 7.4.

Fracture metallic and white like cast steel.

Breaks under the hammer.

It was found in the vicinity of a bed of iron ore, of the argillaceous kind; but no similar piece has been discovered, nor has any effectual search been made for it. Examine for nickel.

60—64. Varieties of Novaculite found in the neighbourhood of this village. No. 60 and 61 are supposed to be the genuine Whet-Slate of Jameson, or Turkey Oil Stone, described in Rees' Cyclopædia. They are partially faced

and in the condition in which they are employed by the joiners of this country, who prefer them to the finest oil-stones of the market. No. 61 is from a large mass which has been used as an oil-stone by a neighbouring joiner for several years. Having become very smooth by use, it possesses a considerable degree of beauty, presenting a clear ground of olive green, clouded and veined like certain valued marbles. The place where Nos. 60 and 61 were obtained, is seven miles directly west of this village. The slate appears in three sloping parallel ridges, extending north and south to an unknown distance. No. 62 was obtained eighteen miles south of the place which afforded Nos. 60 and 61, but in the same range on the south side of Haw River. It is used there for whetstones, but is suited to coarser instruments than Nos. 60 and 61, and is used with water. It is also employed for grind-stones, for which purpose it is said to be admirable. No. 63 is a coarse specimen of the same. No. 64 another kind used with water.

65 and 66. Slates contiguous to the Novaculite. This county (Orange) is distinguished for Slate, containing, beside those just mentioned, a great variety of Argillite, Clorite, and Greenstone Slates. Some of the argillites near Hillsborough appear to be of the kind called *Alum Slate*; and the great quantities of pyrites disseminated through many others, indicate materials for Alum and Copperas.

67. *Fine Clay* from a bed in Rowan County.

68. *Petrosilex*, near the Novaculite, six miles west of this village, forming a ridge parallel to that. When first taken from the ground, it may be scratched with a knife, and polished without difficulty; but it hardens on drying. When polished, the shining black ground, variegated with white specks, renders it quite ornamental. It is extremely abundant, appearing likewise at numerous places in the beds of Haw and Rocky Rivers, (branches of the Cape Fear) and composing a magnificent structure at the Falls of the Yadkin, in the County of Montgomery.

69. The same, from the Falls mentioned in 68.

70. *Tourmalin* crystallized in mass, from Stokes—common in the upper parts of Virginia.

71. *Plumbago* of Wake—best quality slaty.

72. The same of an inferior quality, fibrous.

73. Slaty and fibrous mass, found in detached pieces among the plumbago.

74. Hornstone passing into flint, found in nodules, often four inches in diameter, near this village.

75. *White Marble* from Hagerstown, Maryland, resembling the statuary marble of Vermont.

76—7. *Foliated Talc* from Stokes.

78. *Fibrous Gypsum*, Western part of N. C.

79. *Agate*, from Stokes.

80—7. Specimens designed to illustrate the Plumbago formation of Wake County, viz.

80. Close grained slaty of the best quality.

81. Friable when dug from the pit, but hardens on drying.

82. Same as 80 with a vein of Tremolite. This frequently appears between two contiguous layers of slate, and sometimes in detached pieces as in 73.

83. Rock that forms the bed of the plumbago, taken from the walls.

84. Micaceous Rock that accompanies the Plumbago, same as 83, freed from the Plumbago. This rock has been described in No. 22. It is most commonly red, but sometimes as in the next specimen.

85. White Micaceous rock, associated with Nos. 84 and 87.

86. *Micaceous Sandstone*, occurs on the western side of No. 84, between that and the great sandstone formation, much valued for whetstones and grindstones for softer instruments. No. 18 is a variety of the same.

87. *Yellow Micaceous Rocks*, associated with Nos. 84 and 85.

Of this immense formation of Plumbago,* I propose to furnish a more particular account, and also of a number of other articles comprised in these notes.

* Appearing, as I am credibly informed, fifteen miles from N. to S. and in some places three fourths of a mile in breadth.

ART. X.—*Several other Catalogues of Rocks and Minerals presented to the American Geological Society*

I. From Col. GIBBS.

1. Several magnificent specimens of the Granite of Chesterfield, with its tourmalins, red, green, blue, &c.
2. Do. with its various coloured mica, straw, violet, red, blue, &c. with imbedded tourmalins.
3. Rose coloured mica detached, very beautiful, same locality.
- 4.* Brucite, crystallized in primitive limestone. Brucite is said now to be the same mineral that is called by Professor Berzelius Chondrodit.
5. Haddam granite, with large crystals of chrysoberyl imbedded—garnet in crystals of great size pervades the mass.
6. Do. with imbedded beryl, 5 inches by 3.
7. Do. do. do. do. distinct and handsome, 4 inches by 1, with tourmalins.

II. From JAMES PIERCE, Esq.

8. Gray sandstone, Catskill mountains, the round top exhibits rocks of this character.
9. Dog tooth spar, Schuyler's mine, New-Jersey.
10. Argillaceous schist, found under greenstone, We-hawk, New-Jersey.
11. White graphite in limestone, from the western base of the Highlands, Hamburg, New-Jersey.
12. Sulphate of iron, Morris County, New-Jersey, near Green-pond. At this place copperas was manufactured during the late war.
13. Radiated asbestos, from rocks in place, situated in the primitive district adjacent to New-York—called tremolite by Dr. Bruce.
14. Tubepores, Catskill.
15. Granite, with black mica, from the primitive region four miles from New-York.

* The analysis of this mineral by Mr. Seybert will be found in this Number—it is called by him *Maclurite*.

16. Lenticular crystals of calcareous spar, with quartz crystals, sulphate of lead and iron, Columbia County, near Catskill.

17. New-Jersey pectinites, near Ramapough.

18. Red argillaceous sandstone of this character, stratified, and in nearly horizontal positions, in many parts of the Catskill mountains, alternates with gray sandstone from the base to the summit.*

19. Datholite, calc spar, and green earth, Patterson.

20. A reddish brown graywacke, of this rock, the mural precipices of Raffenberg and Green-pond mountains, Morris County, New-Jersey, are composed.

21. Conglomerate, mostly feldspar and quartz, under greenstone Pallisadoes, New-Jersey.

22. Madrepores, found 60 feet below the surface at Corlaer's Hook, New-York.

23. Granite from a wide and deep vertical vein in granular limestone, Kingsbridge.

24. Chalcedony, Pacquenack mountain, near Pompton plains, New-Jersey.

25. Greenstone, Patterson, New-Jersey.

26. A vein of crystallized Carbonate of magnesia, Staten-Island.

27. Kingsbridge marble, white, crystallized.

28. Toadstone and Patterson Amygdaloid, the carbonate of lime exposed to the air has decayed, giving the specimen a volcanic aspect.

29. Chalcedony and Cacholong, Pracknes mountain, New-Jersey.

30. Serpentine and Amianthus, Hoboken.

31. Ferruginous puddingstone, High-hills of Neversink.

32. Anomias and Terebratulas.—I found this specimen connected with a solid mass on the Catskill mountains, 1500 feet above the Hudson.

33. Catskill encrinites.

34. Feldspar, found in quantity connected with decomposing feldspar and quartz rock, and Kaolin, Weehawk, New-Jersey.

35. Granular limestone, Singing, Westchester County, New-York.

* Now believed to be varieties of graywacke slate, as observed (June, 1822) by Mr. Pierce and the Editor in a tour over the Catskills; this is understood to be Mr. Eaton's opinion also.

36. Quartz, imbedded in greenstone, with sulphate of iron, Pacquenack mountain, New-Jersey.

37. Madrepomite, found fifty feet below the surface in excavating at Corlaer's Hook, New-York.

38. Epidote from a rock of sienite, containing stilbite, West-Chester.

39. Prehnite, Patterson, green mamillary.

40. Marine petrifications. This specimen is characteristic of the rock composing the nucleus of a mountain range, extending thirty miles, commencing near Esopus, and running two miles west of Catskill.

41. Scaly talc, Staten Island.

42. Stilbite, greenstone range near Scotch plains, New-Jersey; mesotype?

43. Encrinites, Catskill.

44. Native Hydride of Magnesia, Hoboken.

45. Magnesite, Staten Island.

46. Brucite, Sparta, Sussex County, New-Jersey.

47. Granular limestone, with brown tourmaline, Kingsbridge.

48. Cellular quartz, Staten Island.

49. Friable granular limestone, with a vein of Calc spar, Kingsbridge.

50. Gneiss, near Kingsbridge, much used in New-York.

51. Indurated talc, Staten Island.

52. Oxide of iron and manganese, New-York, three miles from the city.

53. Greenstone, Hudson river.

54. Analcime, Patterson.

55. Steatite, Staten Island.

56. Terebratulites, Catskill.

57. Fine grained greenstone, Weehawk, New-Jersey.

58. Fine sandstone, quarried under greenstone, Pracknes mountain, New-Jersey.

59. Purple and gray sandstone, under greenstone Palisadoes.

60. Brown Hematite, Staten Island.

61. Greenstone, Palisadoes, New-Jersey.

62. Quartz, with a slight amethystine tinge, and with cuneiform cavities, Patterson.

63. A rock with an argillaceous base, alternating with sandstone, under greenstone Palisadoes.

- 64. Sandstone of this character is frequently observed as the basis layer at the Palisadoes, New-Jersey.
- 65. Greenstone, Pracknes mountain, New-Jersey.
- 66. Quartz with rhombic cavities, that once contained rhombic spar.—Pyritous copper, small crystals of quartz, Fort Lee, New-Jersey.
- 67. Prhenite, Patterson.
- 68. Sulphuret of iron, Highlands in Bergen County, New-Jersey.
- 69. Sulphuret of copper, Schuyler's mine, New-Jersey.
- 70. Chromate of iron, Staten Island.
- 71. Galena, Columbia County, near Catskill.
- 72. Carbonate of copper, with radiating groups of quartz, Patterson.
- 73. Red oxide of zinc, Sparta, New-Jersey.
- 74. Granite, Highlands, near Fort Montgomery.
- 75. Quartz and decomposing felspar, Weehawk, New-Jersey.

III. From Professor DEWEY.

- 76. Gneiss—mica and clay and chlorite and steatitic slate—granular limestone—gray wacke—sand stone—pudding stone—with tourmaline and bitter spath imbedded.
- 77. White fibrous Tremolite—one mass 21 inches by 9, effervesces.
- 78. Do. distinctly crystallized—isolated crystals like those of the Alps.
- 79. Siliceous slate—actinote of Middlefield, handsome.
- 80. Calc. tufa and marl from Williamstown.
- 81. Richmond—stalactical hydrargylite—bitterspath and green talc—Middlefield.
- 82. Stalagmite—Sinter Lanesborough cave.
- 83. Fetid Dolomite.
- 84. Beautiful green talc Newtown Vermont.
- 85. Siliceous limestone, Williamstown, 16 per ct. of silica.
- 86. Chalcedony—Middlefield—partly agatized and well characterized. Very fetid quartz, Williamstown.
- 87. Molybdena in Actynote, and steatite Middlefield.
- 88. Staurotide in mica slate, Sheffield.
- 89. Serpentine Middlefield.

90. Serpentine Middlefield, with Magnetic oxyde of Iron.

90. Whinstone (West Hill)

91. Brown Hematite (Lenox)

92. Talcose slate (West of Williamstown)

93. Schorl in mica slate.

94. Actynolite.

95. Magnetic Iron Sand—great falls thirty-five miles above Glenn's Falls.

96. Oxyd of Manganesc—Adams

97. Gibbsite (Dr. Torrey) Richmond, Mass.

IV. From Doctor BROWN, of Kentucky, through Colonel GIBBS.

98. Petrifications, siliceous, calcareous, and even in some cases agatized, chiefly of the coral family, entrochi, &c. also sulphate of Barytes with Galena—6 miles north of Nashville, Tennessee; in the channel of a little creek commonly dry. Many of them, however, from the highest lands, from the plantation of Mr. Craighead.

V. From Dr. Alfred MONSON.

99. A suite of the Chesterfield minerals—American siliceous spar—tourmalines—sappar, &c. very handsome.

VI. From Messrs. EATON and BECK.

100. Petrifications of the Helderburgh.

101. Limestone in argillite Cahoes falls.

102. Gray wacke—Norman's hill.

103. Pentacrinite—terrebratulite, &c. in sandstone in Helderbergh.

104. Schist of the Mowhawk at Niskeuna, full of Pentacrinites—stytrites—terrebratulites.

Siliceous slate, Bethlehem.

105. Marls, clays, ochres, alum, &c. Helderburgh.

106. Pectinites in schist—Rensselaer county.

107. Green coccolite in bluish crystallized carbonate of lime—very beautiful—Sheene—Essex Co.

108. Euclerite—Marble polished and handsome Coeymans.

109. Handsome crystallized Calcareous spar—Helderburch.

110. Comallilite, Bern.

111. Bog Iron—Watervliett.

112. Turbinite Helderburgh—Accomite.

113. Gryphite—Trilobite.

VII. FROM WILLIAM MACLURE,* Esq. President of the Geological Society.

115. Iron, in and with primitive rocks—Philippstadt Iron Mines, Sweden.

116. Many rocks near Clermont—France—St. Julien—Montagne—Lyons, &c. very many granites and other primitive rocks, and granite aggregates.

117. Many volcanic pieces from the Puy de Dome—Clermont and their vicinity—among them are compact and porous lavas with imbedded minerals—some appear to be connecting links between pumice and terrass.

118. Compact and shell limestones and sand stones from Lyons and the Rhone.

119. Primitive rocks and gray wacke from mount Cenis. The highest point of the passage of this mountain is schist with veins of quartz—primitive slates are the prevailing rocks on this mountain.

120. Compact limestone from the Loire and Montbrun.

121. Serpentine from Auginiana where it forms the foot of the hill.

122. Chalk from Aubure where it is covered by a current of lava from the west.

123. Sand stone with vegetable impressions—village of Raynal.

124. Gypsum alternating with schist at Modane.

125. do. graywacke and limestone.

VIII. From Dr. J. PORTER, of Plainfield.

126. Mica slate Cummington.

127 Porcelain clay Plainfield.

* Mr. Maclure's specimens amount to nearly 500. In the above catalogues the number occasionally indicates not single specimens, but rather groupes of specimens.

128. Several specimens of rock composed of well defined crystals of black hornblende imbedded in white granular quartz, containing occasionally crystals of garnet and spangles of mica. We scarcely know what to call this aggregate. It forms very beautiful specimens, and looks as if it might have belonged to gneiss.

129. Rock composed of Tremolite, garnet and actynolite crystallized.

120. Black Tourmaline in milky quartz—Hawley.

131. Gneiss rock with hornblende—Plainfield.

132. Irised Quartz—Plainfield.

133. Mica slate—Cummington.

134. Stalactite, (Lanesborough Cave)

135. Rock composed of minute crystals of hornblende interspersed with granular quartz.

136. Chlorite Slate (Cummington)

137. Mica, nearly black, &c. &c.

IX. From Doctor T. D. PORTER.

Crystals of the Zircon of Buncomb County, North-Carolina—specimens from this locality are described page 229, Vol. III.—Note.

X. Doctor J. ALLEN, Brattleborough, Vt.

- No. 1. Schorl in Quartz, Brattleborough, Vt. large and fine.
 2. Hornblende, New-Fane, Vt.
 3. Staurotide in mica slate, Chesterfield, N. H. large crystals.
 4. Scaly Talc, New-Fane, Vt.
 5. Granite, Hinsdale, N. H.
 6. Zoisite, Wardsborough, Vt. very large and distinct crystals.
 7. Acicular Actynolite in Talc, Newfane, very handsome.
 8. Mica, Hinsdale, N. H.
 9. Fibrous Actynolite, Windham, Vt. very good.
 10. Granular Quartz, Vernon, Vt.
 11. Mica slate, passing into granular Quartz, West River, N. H.—Staurotide.
 12. Sienite Newfane, Vt.

13. Hornblende Slate, Brattleborough, Vt. It occurs also at Newfane.
 14. Bitter spar, Marlborough.
 15. Magnetic Oxide of iron.
 16. Dolomite, Jamaica, Vt. in this the magnetic Oxide of Iron occurs.
 17. Steatite, Marlborough.
 18. Siliceous Limestone, Putney, imbedded in argillite—also at Brattleborough, Vt.
 19. Green Fluor Spar, Putney, Vt. this is nearly exhausted.
 20. Mica Slate, Jamaica, Vt.
 21. Serpentine, Putney, Vt.
 22. Green foliated Talc, Windham, Vt.—fine.
 23. Roofing Slate, Brattleborough, Vt.
 24. Schorl, Hinsdale, N. H.
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ART. XI.—*Geological Poems.*

THERE are few departments of nature which have not been tributary to poetry, as affording either subjects of verse, or figures and images by which it is illustrated and adorned.—Agriculture furnished to the Mantuan bard the rich theme of his *Georgics*.—Doct. Darwin in our own times has found among plants a fruitful topic of allegorical love.—Some of his satirists have written upon the loves of the Triangles, and the world has been furnished even with piscatory *Eclogues*.—We believe however that rocks and minerals, and the generalizations and theories of Geology have rarely, if ever, offered any temptations to the muses—for who would think that topics generally regarded as so dry and repulsive, are capable of being clothed in a form susceptible at once of poetical embellishment, and of didactic instruction.—These remarks have been caused by the perusal of some poems written at Oxford, and published in London in 1820, which are certainly curiosities both in literature and science—as they are almost entirely unknown in this country, and are at once specimens of skilful poetry, and of a lucid exhibition of geological facts and doctrines—we have thought that the republication of some of them would not be inconsistent with the gravity of this work, and

would probably prove both instructive and amusing to our readers. We have rarely seen in any form a more condensed exhibition of the principal facts and doctrines of the Wernerian Geology, than are contained in the *POETICAL GEOGNOSE*, which, with the *GRANITOGONY* and the *GEOLOGICAL COOKERY*, we now republish with all their appendages of preface, arguments and notes.—A very few passages indicate in the poet an imagination perhaps rather too warm, but we have not thought it worth while to maim the verse by dissecting them out.

A POETICAL GEOGNOSE.

PREFACE.

The external part or crust of the globe, wherever it has been extensively examined, is composed of different rocks, generally arranged in beds or layers over each other; and these beds appear to have been consolidated at different epochs. Many of the beds contain remains of extinct genera or species of animals; and certain species are often peculiar to certain beds, above or below which they are never observed. Now it is evident that the animals whose remains are imbedded in the lower rocks, could not have been cotemporaneous with those found in the upper, by which they are covered: hence the different ages of these rocks are proved.

The lowest rocks that we are acquainted with contain few or no remains of organic life; but from their position it is inferred that they have been formed at different periods: the lowest are supposed, with certain limitations, to be the oldest. It is also well deserving attention, that the animal remains in the lower rocks belong exclusively to the simplest forms of organic life: namely, to moluscous animals and zoophytes; and that the remains of vertebrated animals, or such as possessed a brain and spinal marrow, never occur in or below the regular coal strata.*

* This position has been recently objected to; but the author is of opinion that its truth has not yet been invalidated. He is also fully convinced that all the writers who have hitherto attempted to apply Werner's arrange-

It has been further observed that in the order in which rocks are placed over each other, there is an approximation to a regular succession in every part of the globe, with the exception of certain rocks supposed like the volcanic to be formed by subterranean fire, and which cover other rocks without any regular order. Though the whole series of rock formations enumerated at p. 6, may never have been observed together in any one situation, yet wherever they do occur, the rocks placed at the top of the series, are never found under any of the others. Chalk, or green sand, sometimes rests immediately on lias limestone, or red sandstone, without the intervention of the oolites, but we never find the oolites above chalk. Some of the rock formations do not extend to every part of the globe: thus chalk and oolite are not found in Wales or the north-west part of England; and, according to Humboldt, they are entirely wanting over a great part of South America. It still remains true, that wherever different formations are observed over each other, there is an approximation to a regular order of succession:—to trace this succession is the most important part of the science denominated Geology.

The author thought it might be useful to describe the order of succession of the principal rocks, in an amusing form, divested of all unnecessary technicality, that the subject might be the more easily understood and remembered. This is the utmost merit to which the Poetical Geognosy lays claim.

The *Geological Cookery* is intended to impress on the memory of the student the structure of aggregated rocks.

London, January 22, 1820.

ment to the Geology of England, have made the most important mistakes; mistakes which have introduced much confusion, and prevented the Geologists on the Continent from understanding the description given of the geology of this country. He trusts he shall make this apparent in a work he is preparing for publication.

POETICAL GEOGNOSEY;

OR

FEASTING AND FIGHTING.

*Ter Neptunus aquis cum torro brachia vultu
Exserere ausus erat : ter non tulit aeris æstus.*

OVID. Met. lib. 2.

THE ARGUMENT.

The Poem commenceth with the beginning of things : the scene of the action is laid under the ocean ; and the Poet proceedeth to describe the order of succession of the various rocks. Their frequent dislocations are hinted at (line 7).—Granite is first seated at the bottom : Gneiss and Mica-slate are seated next to Granite ; the distortions of Gneiss, and its frequent intermixture with Mica-slate (line 14 to 19).—The series of Slate-rocks follow, intermixed with the Lower Limestones (line 22).—The origin of Limestone from the oxidation of calcium (line 26).—Porphyry, Eurite, Greenstone, and Sienite, occur without any regular order of succession ; they often lie unconformably over other rocks, and are supposed by some geologists to be the products of fire (line 32—45).—Serpentine often connected with Mica-slate (line 51).—Character of Grauwacké (line 55).—Great Limestone filled with remains of eocrinites (*entrochi*) contains large caverns (line 60).—Series of Coal strata (line 62).—The Red Sandstone or Red Marle which covers Coal strata contains Rock-salt and Gypsum (line 69) ;—it lies under Lias Limestone, and sometimes incloses Magnesian Limestone (line 73).—The Oolites and various strata with which they are associated are seated above Lias Limestone (line 75).—Chalk and Chalk-marle spread along the coast in many parts of England and France ; they are therefore seated close to Neptune (line 78).—Partial formations of strata, deposited after the Chalk, in detached lakes (line 81).—Gravel and black Earth near the sides of rivers contain the teeth and bones of the mammoth and other extinct species of large mammalia (line 80—85).—Strata round Paris ; the lowest bed, the *Calcaire Grossier*, is filled with Cerites, and the Marle above it with Lymnites (line 86—91).—An enumeration of the most remarkable fossil organic remains (line 94).—Oviparous vertebrated animals, such as lizards and fish, occur plentifully in Lias Limestone, and the latter sometimes in Magnesian Limestone (line 105).—Coal strata contain almost exclusively remains of vegetables (line 110).—The Great Limestone filled with Eocrinites (line 112).—Organic remains more rare in the Lower Limestones (line 113 ; occur occasionally in Slate (line 115).—White Statua-

ry Marble and the lower rocks contain no organic remains, but are the repositories of metallic ores and various precious minerals (line 124—134).—The Poet now proceedeth to relate the changes produced on the crust of the globe by the agency of Pluto or subterranean fire.—Basaltic rocks frequently crystallized in columnar ranges, during their consolidation (line 147).—Greenstone and Eurite are described as beginning to run or melt (line 151).—Dark lavas and basalts appeared to have been formed of the former, and whiter Lavas and Clink-stones of the latter.—Porphyry is with much reason believed in many instances to have been liquified by fire.—In Auvergne and other districts there are porphyritic rocks which appear to have been softened by heat, and again consolidated in their original position, or *in situ*, without ever having flowed as lava (line 156).—The Poet referreth to the conflict of the two contending elements when these great changes were taking place, and then his muse desireth him to conclude.

GEOLOGICAL ORDER OF SUCCESSION.

Alluvial soil and gravel.
Partial series of Strata over chalk.

Chalk and Chalk Marle.

Red and Green Sand.

Various Oolites, &c.

Lias Limestone and Clay.

Red Marle or Sandstone with Gypsum,

Rock-salt and Magnesian Limestone.

Sandstone, Shale, and Coal.

Great Limestone.

Sandstone, Coarse Slate, and Grauwacqué,

Various Slate-rocks, containing beds of
Lower Limestone.

Mica-slate, sometimes with white Limestone and Serpentine.

Gneiss.

Granite.

The following rocks frequently occur without any regular order of succession.

Basalt
Lava.

Porphyry, Eurite, Sienite,
Greeustone or Hornblende
rock, Serpentine.

A POETICAL GEOGNOSY.

When Nature was young, and Earth in her prime,
 All the Rocks were invited with Neptune to dine.
 On his green bed of state he was gracefully seated,
 And each as they enter'd was civilly greeted.
 But in choosing their seats, some confusion arose, 5
 Much jostling and scrambling, and treading on toes ;
 Till with some dislocations, and many *wry faces*,
 They at length became quiet, and kept their own places.
 Reveal, heavenly Muse, for I know thou art able,
 How each guest in succession was ranged at the table ; 10
 How the dinner was served, and the name of each dish,
 Whether Nautilite, Ammonite, tortoise, or fish.

First Granite¹ sat down, and then beckon'd his queen,
 But Gneiss² stepp'd in rudely, and elbow'd between,
 Pushing Mica-slate³ further ; when she with a frown
 Cried, " You crusty, distorted, and hump-back'd old clown ! " 16
 But this was all sham,—for to tell you the truth,
 They had been the most intimate friends from her youth.
 But let scandal cease. See the whole tribe of Slates
 All eager and ready to rush to their plates ; 20
 Oh heav'ns ! how the family pour in by dozens,
 Of brothers, and sisters, and nephews, and cousins !
 The elder-born Limestones ran in between these,—
 They were very well known to be fond of a squeeze.
 Now, before we proceed with our story, it meet is 25
 That we hint at th' amours of Calcium and Thetis :
 But the tale shall be short. 'Tis agreed by the sages,
 Hence sprang all the limestones of different ages :
 The oldest look'd white⁵ ; and no wonder she should,
 She had never once dined upon animal food. 30

1 See Granitogony and Geological Cookery.

2 Gneiss.—This rock is composed of the same minerals as Granite, but it has a slaty structure ; its beds are often much distorted, and intermixed with Mica-slate.

3 Mica-slate.—A shining shistose rock, composed principally of Mica and Quartz.

4 Among Slate Rocks we may enumerate, as the principal, Clay-slate, of which Roofing-slate is a variety ; Talc-slate, or Chlorite-slate ; Hornblende-slate ; Flinty-slate ; Drawing-slate : Whetstone-slate ; Porphyritic-slate ; and Alum-slate.

5 The oldest Limestone, or White Statuary Marble, contains no remains whatever of marine or other animals.

Ere these Rocks were all seated, the loud sounding call
 Of "Our places! Our places!" rang shrill through the hall.
 On hearing the noise, the Muse turn'd round her head,
 And saw Porphyry⁶ and Eurite—their faces were red.
 Then Greenstone⁷ and Sienite⁸ follow'd behind,— 35
 Their seats were bespoke (they said) time out of mind.
 Great Neptune rose up, and then swore in a rage
 That each rock should be seated according to age;
 "But let those (where the register cannot be found
 Either under the water or on the dry ground) 40
 Not presume to take regular seats at the table,
 But change places with others, whenever they 're able."
 Thus the last-mentioned rocks were obliged to retire,
 Though their ages were book'd in the office of fire:
 (This they said,) but no soul would go there to inquire. 45
 Leaning over old Gneiss and the Slate-rocks they stood,
 Or else press'd between them, whenever they could.
 Gay Serpentine⁹, clad in a livery of green,
 At Mica-slate's feet during dinner was seen;
 Among the first class it was publicly said,
 He had often been found fast asleep in her bed.
 When these rocks were thus settled, and quiet restored,
 The others more orderly march'd to the board.
 Say, Muse, who is he that is just walking in?
 O! his name is as harsh and as rough as his skin, 55
 He's a cousin of Slate, but he looks wild and cracky,
 And is known as the far-famed illustrious Grau-Waccé.¹⁰
 Younger Slate-rocks, with Sand-stone, then came side by side,
 And he, the Great Limestone, of limestones the pride, 59
 Who has caves with wild echos resounding and vocal,
 And is called by the masons *grey marble entrochal*.
 The next were a grave-looking set on the whole,
 Who came in a group to accompany Coal.
 Coarse grit-stones, with sand-stones, and clay-binds, and shale.
 Some were hard, some were soft, some were dingy, some pale; 65

6 For the composition of Porphyry see Geological Cookery.—Eurite; see Primer.

7 Greenstone; see Diabase, Primer.

8 Sienite.—A rock similar to Granite, but containing a mixture of a dark mineral called Hornblende.

9 Serpentine, the prevailing colour of this rock is green. It often occurs imbedded in Mica-slate.

10 Slate appears to pass by gradation into coarse grit stone, by the mixture and increase of Quartz or sandy particles, and is then called Grau-Waccé. The French Geologists class Grau-Waccé and many of the Sand-stones together, under the name of Psammite, and more recently under that of Thaumite. These terms are no improvement either in sense or sound.

They oft proved deceitful when thought very sound,
 For they had many *faults*¹¹, which they hid under ground.
 Red Sand-stone came after, and licking his lips,
 He brought in the salt, on a salver of Gyps.
 To two sister limestones he had a strong bias, 70
 The one was *Magnesian*¹², the other was *Lias*.
 Though the former look'd sallow, he press'd the dear charmer
 So close, his attentions did sometimes alarm her :
 But *Lias* was *flat*, and seem'd sombre and dull, 74
 For with shell-fish and lizards her stomach was full.
 Then *Oolites*¹³, with sandstones, and sand red and green
 In a crowd, near the top of the table were seen.
 The last that were seated were *Chalk-marl* and *Chalk*,
 They were placed close to *Neptune*, to keep him in talk.
 Now the God gave his orders, "If more guests should come, 80
 Let them dine with the *Lakes*, in a separate room."
 As for *Gravels*, and *Black-earth*, and other gross livers,
 They may feast out of doors, by the side of the rivers.
 Kill *Aurochs*¹⁴ and *Mammoths*, not heeding their groans,
 But let them take care of the teeth and the bones."
 The *Strata* from *Paris* arrived very late, 86
 With letters, requesting a chair and a plate.
 "*Eh bien*," said the God, with a good natured air,
 "*Faites entrer Monsieur le Calcaire Grossier* ;
 Let him and his friends at a sideboard be placed, 90
 And with *Cerites*¹⁵ and *Lymnites* the covers be graced."
 Now, *Muse*, raise thy voice, and be kind to our wishes,
 And tell us the names of the principal dishes.
 To *Chalk*, preserved palates and fossil *Echini*
 Were handed in *Cham-shells* more pearly than *China*.

11 Faults or dislocations—frequent in coal strata, and occasion much inconvenience to miners.

12 *Magnesian Limestone*, and *Lias Limestone*.—*Magnesian Limestone*, generally of a yellow colour, sometimes contains remains of fish. *Lias Limestone* occurs in flat and nearly horizontal strata, some of which abound with remains of oviparous quadrupeds, Lizards of enormous size, together with remains of scaly fish, *Ammonites*, *Gryphites*, and *Pentacrinites*.

13 *Oolite*, or *Roe-stone*.—*Portland stone*, *Bath stone*, and *Rotten stone*, are *Oolites*, or *Roe-stones*.

14 *Aurochs* and *Mammoths*. *Auroch* a species of ox, whose bones are found in gravel and alluvial soil. *Mammoth*, the fossil elephant ;—the teeth and bones are frequently found in gravel and alluvial soil in England, and are very common in *Siberia*.

15 *Cerites*.—Fossil shells in the strata of *Paris*. The *Lymnites* are a species of fresh-water snail.

Then Alcyonites¹⁶, Nautilites¹⁷, graced a tureen,
 With Belemnites tastefully stuck in between.
 The Oolites were served with a wondrous profusion
 Of Bivalves, dished up in apparent confusion.
 There Trigonias¹⁸, Anomias, and Arcas were placed,
 And each rock took the species that tickled his taste. 101
 At this juncture some Limpets¹⁹ were sent in on one dish,
 From our worthy friend Halifax, vicar of Standish.
 Now oviparous creatures, in which the back-bone is²⁰,
 Were hash'd with remains of the Cornua Ammonis.
 They were bringing in more; but great Neptune cried "Halt! 106
 Place no vertebral animal lower than Salt²¹:
 Those grits, and those shales, hold inflammable matter,
 Let no lizards or fishes e'er smoke on their platter:
 Give them fern-leaves, and palm-stalks, and such like spare
 diet, 110
 And Coal and Pyrites will keep very quiet.
 The Great Limestone full plates of Encrini will want,
 To some of the others a few you may grant:
 Feed the lower with Coral; and some of the Slates
 May have Shell-fish most sparingly spread on their plates. 115
 The eldest born Limestone, whose colour so white is,
 Of Mica and Talc-slate the well known delight is;
 With Granite and all the old Rocks she shall fare.
 And dine on bright Crystals, both costly and rare."
 The commands of great Neptune were duly observed,
 And their dinner in state was most splendidly served.
 Yellow Topaz, red Garnets, and Emeralds, we're told,
 Were sent under covers of bright burnish'd gold,
 With Schorl's red and green, and blue Sapphires and Beryl;
 But the Muse thought this diet too arid and steril, 125

16 Alcyonite. A fossil Zoophite, somewhat resembling a fungus.

17 Nautilite, the fossil Nautilus. Belemnite:—This well-known fossil, vulgarly called thunder-bolt, is frequently about the length and thickness of the finger, but is pointed at the lower extremity. It is classed by Lamarck with univalve shells, having many cells, like the Nautilus. It has been sometimes called the straight Nautilus. The genus is extinct.

18 Trigonias, &c. Some of the genera of Bivalves, common in many limestone strata.

19 Limpets. This fossil is extremely rare. It is found in the Oolite formation, in some quarries near Stroud in Gloucestershire. Specimens of it were presented to the author by the Rev. R. H.

20 Lizards and scaly fish.

21 Lower than Salt. The author is decidedly of opinion, that all the accounts of remains of vertebrated animals found in strata below the red Marle, or Sandstone, containing salt or gypsum, are erroneous, and have originated in a mistake respecting the true Geological position of the strata. Fresh water muscles occur rarely in some of the coal-shales of Yorkshire and Derbyshire, and also in Flanders.

So she moved from the seat of such infinite splendour;
 For, like us, she loved something more juicy and tender.
 Long lasted the dinner—No rock from his seat
 Ever moved, or evinced the least wish to retreat;
 And old Neptune found out, as the wise ones aver,
 When the rocks are once seated, they love not to stir.
 So he rose unobserved, and began to retire;
 But 'tis whisper'd the Sea-God already smelt fire.
 Be this as it may—a deep hollow sound,
 Still nearer and nearer was heard under ground; 135
 'Twas the chariot of Pluto,—in whirlwinds of flame
 Through a rent in the earth to the dinner he came.
 “ Oh, by Styx and by Hecate, my rage I wont smother,
 What—Nep give a feast, without asking his brother?
 Though I am King of Hell—what, am I such a sinner
 That I can't be invited to smoke after dinner? 141
 Let Nep with his waves and his waters all go to—
 I'll make the rocks dance, or my name is not Pluto.”
 Thrice he stamp'd in a rage, and with crashes like thunder 144
 The earth open'd wide, and the rocks burst asunder,
 And the red streaming lava flow'd over and under.
 It spread far and wide, till grim Pluto said “ Halt!”
 And ranged it in columns and files of Basalt!
 For he saw Neptune coming, collecting his might,
 And roaring and raising his waves for the fight. 150
 Now were Eurite²² and greenstone beginning to run²³,
 Which Hutton and Hall²⁴ said was excellent fun.
 But a rock-rending scene in the sequel it proved,
 E'en the hard heart of Porphyry was melted and moved. 154
 And many a rock the muse could not draw nigh to,
 She saw very plainly was soften'd *in situ*.
 Now thick vapours of Sulphur and clouds black as night,
 Roll'd in volumes, and hid the whole scene from the sight;
 And the Muse told the Poet 'twas time to take flight:
 Adding this—“ My good fellow, pray leave off your writing, 160
 We have had quite enough both of feasting and fighting.”

22 For Eurite see note p 22. Compact Eurites have been classed by geologists under the indefinite and frequently misapplied denominations of Compact Felspar. The lavas which melt into a black glass are formed from Greenstone, principally composed of Augit and Felspar, and those which melt into a white glass of Eurite, in which Felspar is the predominating ingredient.

23 Run or melt. Alluding to the fusibility of these rocks.

24 Dr. Hutton and Sir James Hall, the well known supporters of the theory which ascribes the formation of these rocks to the agency of heat. The latter has supported his opinions by a series of the most interesting and satisfactory experiments. See Transactions of the Royal Society of Edinburgh.

GRANITOGONY,

OR

THE BIRTH OF GRANITE.

The Granitogony was written in 1811, when the author was on a visit at Derby, the former residence of Dr. Darwin. In the company of a few scientific friends it was suggested, that, if the Doctor had lived to see the progress of Geology, he would have favoured the world with another poem, "The Loves of the Mountains." Impressed with this idea, the author, on the following day, to amuse a long and solitary walk in December, composed the annexed verses, *studio minuente laborem*. They were written and shown on his return, and the Moral was afterwards added. The reason for the present publication is given in the Preface. At the period when this poem was composed, the author was more disposed to adopt the theory of those philosophers who assert that the world has been baked, than that of the German Geognosts, who assert that it has only been boiled. He now inclines to a midway faith; and is disposed to believe that the crust of our planet has been stewed, fire and water being equally operative in its formation.

In ancient time, ere Granite¹ first had birth,
And form'd the solid pavement of the earth,
Stern Silex² reign'd, and felt the strong desire
To have a son, the semblance of the sire.
To soft Alumina³ his court he paid,
But tried in vain to win the gentle maid;
Till to caloric and the spirits of flame
He sued for aid—nor sued for aid in vain:
They warm'd her heart, the bridal couch they spread,
And Felspar⁴ was the offspring of their bed:

1 Granite.—This rock is essentially composed of three minerals, Quartz, Felspar, and Mica united, without any cement, or without interstices between them; frequently the three minerals appear to penetrate each other. Hence it has been supposed that these minerals were crystallized and united when the mass was in a state of fusion.

2 Silex.—This earth is one of the principal constituent elements of the three minerals that form Granite. Quartz is nearly pure Silex; it is more imperishable than Felspar or Mica.

3 Alumina.—This earth is soft and unctuous when moist. It is a constituent part of Felspar, in which it is combined with a large portion of Silex, and with other ingredients. As Silex and Alumina cannot be made to combine chemically by water, the Muse has properly sought aid from caloric to promote their union.

4 Felspar, when crystalline, is distinguished by its laminar structure and smooth shining face.

He on his sparkling front and polished face
 Mix'd with his father's strength his mother's grace.
 Young Felspar flourish'd, and in early life
 With pale Magnesia lived like man and wife.
 From this soft union sprang a sprightly dame,
 Sparkling with life—and Mica⁵ was her name.
 Then Silix, Felspar, Mica, dwelt alone,
 The triple deities on Terra's throne.
 For he, stern Silix, all access denied
 To other gods, or other powers beside.
 Oft when gay Flora and Pomona strove
 To land their stores, their bark he rudely drove
 Far from his coast; and in his wrath he swore
 They ne'er should land them on his flinty shore.
 Fired at this harsh refusal, angry Jove,
 In terrors clad, descended from above;
 His glory and his vengeance he enshrouds,
 Involved in tempests and a night of clouds:
 O'er Mica's head the livid lightning play'd,
 And peals of thunder scared the astonished maid.
 To seek her much-loved parents quick she flew;
 Her arms elastic round their necks she threw,—
 "Thus may I perish, never more to part,
 Press'd to my much lov'd sire's and grand-sire's heart!"
 So spoke the maid. The thunder-bolt had fled,
 And all were number'd with the silent dead.
 But, interfused and changed to stone, they rise
 A mass of Granite⁷ towering to the skies.
 O'er the whole globe this ponderous mass extends,
 Round either pole its might arms it bends;
 And thus was doom'd to bear in after time
 All other rocks of every class and clime.
 So sings the bard that Granite first had birth,
 And form'd the solid pavement of the earth:
 And minor bards may sing, whene'er they list,
 Of Argillaceous or Micaceous Schist.

5 Mica.—The descent of mica may be rather dubious: the quantity of Magnesia which enters into the composition of this mineral, as given in some analyses, is very small.

6 Siliceous earth alone is extremely unfavourable to vegetation, and granitic rocks, in which this earth abounds, remain for ages denuded and barren.

7 Granite forms the summits and peaks of lofty mountains. It is also supposed by geologists to be the lowest rock with which we are acquainted, forming a foundation for other rocks in every part of the globe.

MORAL⁸.

Learn hence, ye flinty hearted rocks,
 Your burthens all to bear,
 Lest Jove should fix you in the stocks,
 Or toss you in the air.

GEOLOGICAL COOKERY.

To make Granite.

Of Felspar and Quartz a large quantity take,
 Then pepper with Mica, and mix up and bake.
 This Granite for common occasions is good ;
 But, on Saint-days and Sundays, be it understood,
 If with bishops and lords in the state room you dine,
 Then sprinkle with Topaz, or else Tourmaline.

N. B. The proportion of the ingredients may be varied *ad libitum*;—it will keep a long time.

To make Porphyry.

Let Silex and Argil be well kneaded down,
 Then colour at pleasure, red, grey, green, or brown :
 When the paste is all ready, stick in here and there
 Small crystals of Felspar, both oblong and square¹.

To make Pudding-stone.

To vary your dishes, and shun any waste,
 Should you have any left of the very same paste,
 You may make a plum-pudding; but then do not stint
 The quantum of Pebbles—Chert, Jasper, or Flint.

⁸ MORAL. The friend to whom this poem was first shown in 1811, suggested the propriety of annexing a Moral. In compliance with general custom, he followed the advice. It would, however have been more consonant to his own modesty, to have left the moral application to the reader's sagacity, than to have thus obtruded it on his notice.

¹ This is the old-fashioned receipt for making Porphyry, used by our grandmothers: viz. they made the paste first, and stuck in the Felspar afterwards. This method is easy and plain: but in the most approved modern receipts, the ingredients are all mixed together at first, and the felspar is left to crystallize while the paste is hardening.

To make Amygdaloid.

Take a mountain of Wacke², somewhat softish and green,
 In which bladder-shaped holes may be every where seen ;
 Choose a part where these holes are decidedly void all,
 Pour Silex in these, to form Agates spheroidal,
 And the mass in a trice will be Amygdaloidal.

To make a good Breccia with a Calcareous Cement.

Break your rocks in sharp fragments, preserving the angles ;
 Of Mica or Quartz you may add a few spangles :
 Then let your white batter be well filtered through,
 Till the parts stick as firm as if fastened by glue.

To make a coarser Breccia.

For a Breccia more coarse you may vary your matter ;
 Pound Clay, Quartz, and Iron-stone, moisten'd with water :
 Pour these on your fragments, and then wait awhile,
 'Till the Oxyd of Iron is red as a tile³.

2 Wacke. See Primer, p. 24. Wacke is generally greenish, and rather unctuous to the touch. This rock must not be confounded with Grey-Waccé.

3 The geological Neophyte who attempts to make aggregated rocks from the above approved receipts, should attend to the following directions :—Granite rocks must be composed of crystalline grains of two or more different species of minerals closely united without any cement—Porphyry, of a base or paste containing imbedded crystals (generally of felspar)—Pudding-stone, of rounded stones plentifully imbedded in a siliceous paste—Amygdaloid, of basalt or wacke inclosing nodules of agate or chalcedony—Breccia, of angular fragments of any kind of rock, united by a cement. When large rounded pieces mixed with fragments are held together by a cement, it is generally called a coarse conglomerate.

BOTANY.

ART. XII.—*A Catalogue of a collection of Plants made in East-Florida, during the months of October and November, 1821. By A. Ware, Esq.—By THOS. NUTTALL.*

THE very imperfect knowledge which we yet possess of the vegetable productions of Florida, and more particularly that part of it now recently ceded to the United States, renders any additional information acceptable, however incomplete. The first enterprising naturalist who visited this delightfully temperate region, was our venerable friend Mr. William Bartram, of Kingsessing, but unfortunately for science, his collections have been consigned to oblivion, though still, I believe, existing in the Banksian herbarium. Doctor Fothergill, his patron, being rather an amateur than a successful cultivator of natural science, never brought forward the result of Mr. Bartram's labours.

The next scientific traveller who visited Florida, was the indefatigable André Michaux, who did indeed describe a few of the peculiar plants of this country; his account, however, is extremely limited, and many of the most remarkable productions mentioned by Bartram are unaccountably overlooked or neglected.

The interesting fasciculus now collected by Mr. Ware, though made at an unfavourable season of the year, indicates the existence of a rich and varied Flora, and of a climate almost congenial to the cultivation of every important commercial production of the tropics.

We have given the collection as we found it, and enumerated those plants which are common as well as those which are new or rare, considering the whole as important, at least in a physical and geographical point of view.

Since Mr. Ware's visit to this country we have been credibly informed of the discovery of the common Fig, the Plantain (*musa paradisiaca*,) and the Bamboo cane, (*Bambos arundinacea*,) near the shores of east Florida, to the south of the 26th degree of latitude. In another small collection I have also seen a species of *Tournefortia*.

MONANDRIA.

Salicornia herbacea. *Willdenow.* and *Pursh.*

DIANDRIA.

† *Gratiola* * *micrantha*, caule erecto, angulato ; foliis lanceolatis acutis serratis basi attenuatis ; pedunculis foliis brevioribus ; calycibus (ebracteatis) quadrupartitis, stamina 4.

OBSERVATION —A species of very unusual aspect; stem irregularly angular? apparently about a foot high, and considerably branched. Leaves narrow, and much attenuated below. Peduncles filiform, scarcely one third the length of the leaves. Segments of the calix 4-parted, naked, calix oval. Corolla (apparently minute, white?) the internal surface of the tube densely covered with hairs. Capsules globose-ovate, crowned with the persisting style. The dissepiments of the 2-celled capsule formed by the inflected margins of the valves coalescing with the seminal placenta. Scarcely perhaps of this genus, but my specimens are too imperfect to warrant any additional remarks.

Pinguicula pumilla. *Mich.* Flor. Am. 1. p. 11.

Gratiola acuminata. *Walter* and *Elliott.* p. 15, not of *Pursh.* *G. anagallidea.* *Mich.* 1. p. 5. Excluding *Pursh* and *Elliott's* synonym of *Lindernia*.

Elytrania virgata *Mich.* 1. p. 9.

Salvia azurea. *Lamark,* Encycl. 6. p. 625. *S. lyrata.* *Lin.*

Piper * *leptostachyon*, herbaceum, pusillum ; foliis obovatis obtusis subtrinerviis pubescentibus ; spicis axillaribus filiformibus erectis foliis multo longioribus. *Hab.* In East Florida.

OBSERVATIONS.—Apparently annual. The stems about a span high, in the dried specimen are clothed with short rufous hairs, which are more or less abundant—also upon the leaves. Leaves opposite, petiolate ; spikes filiform, sometimes more than one in each axill, three or four inches long. Stamens apparently two, persistent with the

fruit. Berries about the size of tobacco seeds. Considerably allied to *P. alpinum* of Jamaica.

TRIANDRIA.

- Tripterella coerulea*, *Muhlenburg's Catalogue. Elliot.*
p. 43. *Nuttall's Genera. Am. Pl. 1. p. 22.*
Dilatris Heritiera. Persoon's Synopsis. 1. p. 54.
Sisyrinchium. anceps. Lam. Encl. 1. p. 403. Willd.
5. p. Pl. 3. p. 579.
Boerhaavia erecta. Willd. Elliot. p. 41.
Xyris caroliniana. Lam. Illustr. 1. p. 132. Walter. Flor.
Carolin. 69. X. Jupicai. Mich. 1. p. 23.
Dichroma Cencocephala. Persoon. 1. p. 57.
Scirpus lacustris. Willd.
Dulichium. spathaceum. Persoon. 1. p. 65.
Arundinaria macrosperma. Mich. 1. p. 74. and Beauvois
Miegia. Persoon. 1. p. 102. Triglossum of Fischer's Catal.
du jardin des plantes, 1812, with a figure, appears to be
nothing more than this plant.
Agrostis indica. Willd. Persoon. 1. p. 76.
Aulaxanthus ciliatus. Elliott.
Panicum Walteri. Pursh. Flo. Am. 1. p. 66. P. gib-
bum. Elliott.
Pennisetum violaceum? Persoon. Synop. 1. p. 72.
Trichochloa sericea. T. capillaris. Decandolle stipa ser-
icea. Mich. 1. p. 54. Agrostis sericea. Nuttall's Genera.
1. p. 44.
Andropogon virginicum. Willd.
Uniola paniculata. Willd. 1 p. 406.
Chloris petraea. Swartz. Flor. 1. p. 194. Persoon. 1.
p. 87.
Monocera aromatica. Elliott. Chloris monostachyd.
Mich.
Rotbollia rugosa. Nuttall's Genera. 1. p. 84.
Lechea minor. Lin.
Erio caulon decangulare? Mich.

TETRANDRIA.

- Rubia Browner. Mich. 1. p. 81.*
Diadia virginica. Willd. 1. p. 580.

- Oldenlandia glomerata. Mich. 1. p. 83.*
Houstonia rotundifolia. Mich. 1. p. 85.
Ludwigia hirsuta, Lamark Encycl. 3. p. 587.
L. linearis. Walter. Flo. Carol. p. 89.
L. lanceolata. Elliott. p. 213.
L. capitata, Mich. 1. p. 90.
Lycium carolinianum. Mich.
Rivina humilis. Willd.
Ilex, opaca. Aiton. Hort. Kew. 1. p. 169.
I. Dahoon Walter. Flor. Carol. 241.
*Ilex. *laurifolia, foliis majoribus ellipticis, subacutis integerrimis semper virentibus, pedicellis elongatis subtrifloris.*
 OBSERVATIONS.—Nearly allied to *I. Dahoon*.
Obolaria virginica. Lin.

PENTANDRIA.

- Purshia. hispida. Sprengel. Onosmodium hispidum. Mich. 1. p. 133.*
Ipomoea maritima. Brown's Prod. Flor. Nov. Holland. p. 486. Convolvulus maritimus. Brown's Jamaica, p. 153.
Ipomoeae. obicularis. Elliott. p. 257. Ic. Botan. Rep. t. 319.
T. Bona nox. Pursh. 1 p. 145. Not perhaps of Linnaeus.
T. mechoacanna. mechoacanna alba. Bankin. T. macrorhiza. Mich. 1. p. 141. Exclude the synonym of T. lalapa. Pursh. 1. p. 146.
Ipomeria coronopifolia, Cantua coronopifolia. Willd.
Phlox divaricata. Lin. Persoon.
Solanum verbascifolium. Willd. Pluck. Almag. 351. t. 316. f. 1.
Capsicum baccatum. Lin. The fruit according to Mr. Ware, is about the size of a pea, somewhat oblong, and, as usual, red when ripe. This species commonly used in Florida as a condiment by the inhabitants, is in common with the Cayenne pepper of Jamaica, called "Bird Pepper." It is the pepper spoken of by my friend Win. Bartram, in his Book of Travels, page 71, and may probably be the *Capsicum baccatum* B. *minimum* of Miller, from which, as well as *C. baccatum*, of its more usual aspect.

The Cayenne pepper of commerce is manufactured. It appears to be perfectly distinct from the capsicum minus, fructu parvo pyramidalis erecto," of Sloane. t. 146. fig. 2. which appears also to afford the Cayenne pepper.

*Psychotria * lanceolata*, stipulis amplexicaulibus subrotundis deciduis; foliis lanceolatis utrinque acuminatis, subtus pubescentibus; pedunculis trichotomis paucifloris.

OBSERVATIONS.—Stem shrubby; the younger branches, and under side of the leaves, more particularly when young, as well as the peduncles, clothed with a ferruginous pubescence. Leaves opposite, two to three inches long, and about an inch wide, prominently and somewhat verticillately veined. Stipules sphacelous, brownish, and deciduous. Flowers not seen. Peduncles mostly terminal, one to two inches long, trichotomal and few flowered. Berries red, ovate; nuts two, externally convex and grooved. One of the specimens is perfectly smooth and produces smaller leaves, but in other respects appears the same.

Ophiorhiza mitreola. Willd.

V. Lanceolata. Elliott. *Cynoctonum petiolatum*. Gmelin. Syst. Veg. 443.

Sabbatia paniculata. Pursh.

S. calycora. Mich. Flor. 1 p. 147.

S. Gracilis. *Chironia gracilis*. Mich. 1 p. 146.

Chiococca racemosa. Willd. Sp. Pl. 975.

Caprifolium sempervirens. Mich. 1 p. 105.

Vitis rotundifolia. Mich.

V. palmata? Persoon. 1 p. 252. This plant, however, scarcely appears to be more than a variety of *V. astivalis*, and instead of being smooth, is tomentose.

Itea virginica. Mich. 1 p. 157.

*Cyrilla * paniculata*. foliis coriaceis cuneato-oblongis obtusis, floribus paniculatis.

OBSERVATIONS.—Nearly allied to *C. antillana* of Michaux, but the flowers are distinctly paniculated. The leaves are sometimes apparently oblong-lanceolate. The petals are oblong and spotted or blotched.

*Plumbago * floridana*, herbacea? erecta; foliis petiolatis ovatis glabris, caule æquali.

OBSERVATIONS.—Scarcely distinct from *P. rosea*, but bearing white flowers like *P. scandens*, of which it may be perhaps a variety.

Rhamnus minutiflorus. Mich.

Ceanothus microphyllus. Mich.

*Herniaria * americana*, procumbens, glabriusculis, foliis lineari oblongis internodiis multo brevioribus, stipulis minutis, fasciculis, paucifloris, cal, laciniis obtusis coarctatis. *P. Anychia herniaroides*, Elliot, not of Michaux.

Perhaps the supposed *Camphorosma glabra*? The stem is clothed with a minute retrorse pubescence. The clusters of flowers contain from about three to five; the upper and inner part of the calyx is whitish.

*Matelea? * laevis*, foliis lanceolatis utrinque acuminatis, umbellis longe pedunculatis, axillaribus, folliculi lævi tereti.

OBSERVATIONS.—Stem herbaceous, and terete with an alternating line of pubescence. Leaves opposite, lanceolate and acuminate, petiolate. Umbels axillary on longish peduncles. Calix five-parted, segments acuminate. (Corolla not seen.) Follicle acuminate at either extremity, smooth and even. Seeds destitute of pappus, (but in other respects resembling those of *Asclepias*, elliptic, with a broadish membranaceous margin, imbricately attached to a somewhat slender unconnected central receptacle. On a careful examination of Aublet's figure and description of *matelea*, I am fully satisfied that it is a congener of the present plant, although we are yet unacquainted with the corolla of this species. The anthers, as they were then considered, though so singularly described by Persoon, (Synopsis, 1. p. 276,) are evidently on the authority of Aublet's description, similar to those of *Asclepias* and *Cynanchum*, to which the genus holds a near affinity. The specimen also collected by Mr. Ware, might from its whole habit be readily taken for an *Asclepias*.

*Cynanchum * scoparium*, denudatum; caule volubili perenne, foliis linearibus remotis, umbellis subsessilibus parvifloris.

OBSERVATION.—Stem green and perennial, striated, and with the exception of the recent branches naked; branches opposite, furnished with an alternating pubescent line.

Branches opposite, leaves narrow, linear, acute, smooth, and membranaceous. Flowers greenish yellow, minute. Segments of the calix very obtuse and short, those of the corolla oblong, with a brownish line towards the base of each. Lepanthium very short, five toothed. Polliniferous cells as in *Asclepias*. Follicles terete, even, and subulate. Seeds linear and immarginate.

Asclepias verticillata. *Lin.*

A. incarnata. *Willd.*

Amsonia Angustifolia. *Mich.*

Gentiana catesbrii. *Walter.*

Eryngium. virginianum. *Persoon.*

E. aromaticum. *Baldwin in Elliot's Flora, p. 344.*

Peucedanum ternatum. *Nuttall's Genra. 1. p. 182.*

Salsola salsa. *Willd.*

Statice Limonium. *Lin. S. Caroliniana. Walter Flor. Car. 118.*

Linum Virginicum. *Lin.*

HEXANDRIA.

Tillandsia * *Bartrami*, foliis ensiformibus attenuatis glabris, panícula multiflora; floribus alternis distinctis. *T. lingulata* or Wild Pine. *Bartram's St. p. 61.*

T. polystachya. *Muhlenberg's Catal.*

OBSERVATIONS.—Leaves all radical, two or three feet long, attenuated, having broad sheathing bases, crowded together so as to form a vase for retaining water. Panicle naked, very large, formed of alternate branches, incumbent on each other, including the scape, commonly about three feet high. The flowers are distinct and alternate, each subtended by an ovate obvallate bracte. (Flower not seen.)

Mr. Ware plucked one specimen from the trunk of a live oak, which he supposed to weigh about fifteen pounds.

T. tenuifolia, *Swartz. Fl. Ind. acc. 1. p. 592.*

T. monostachya. *Bartram's H. p. 61.*

OBSERVATIONS.—Leaves subulate, erect, and about the height of the flower stem, covered as in *U. Usneoides* with hoary surpuraceous scales, scape covered with sheathing bractes, flowers imbricated into a single, linear oblong

spike. In more luxuriant specimens, it is probable there occur the three spikes which characterize this species. (Flowers not seen.) It appears to be very nearly allied to *T. canescens*.

T. recurvata, Flor. Peruv. t. 271. *Lin. Persoon*. 1. p. 346.

Prinos coriaceus? *Pursh*. Flor. 1. p. 221.

OBSERVATIONS.—Leaves sempervirent, oval, or cuneate-oval, subserrate towards the apex, pedicels many-flowered, short, and corymbose.

Crinum Americanum. *Ait. Hort. Kew*. 1. p. 413.

Sabal Adansoni, *Persoon*. 1. p. 399.

S. Histrix. *Pursh*. caudice repente, frondibus palmatis plicatis, axillis spinosis, spadicebus brevissimis, drupis ovoideis, majusculis hirsutis.

OBSERVATIONS.—In this species, whose fronds resemble the preceding, the stipe is naked and triangular, not simply convex beneath; in the basilar axils of which originates a matted tomentose substance, almost similar to coarse brown wool, and intermixed with spines half a foot long, and rigid as needles, within these radical sheathes is inclosed the clandestine spadix loaded with hirsute brownish drupes the size of coffee berries, and when recent possessing an eatable sweetish pulp, with which the aborigines are acquainted.

*S. * minima*, caudice repente, stipitibus subaculeolatis asperis, frondibus palmatis plicatis, subseptemfidis?

OBSERVATIONS.—The frond scarcely exceeds a span in height, and is not a variety of *S. serrulata*, as Mr. Ware observed it to form almost exclusive fields of an uniform appearance.

OCTANDRIA.

Rhexia angustifolia, *Nuttall's Gen*. 1. p. 244.

Oenothera humifusa, *Nuttall's Gen*. 1. p. 245.

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Gaura angustifolia, *Mich.* 2. p. 226.

Polygonum gracile, *Nuttall's Gen.* 1. p. 255.

This species, according to the observations of Mr. Ware, attains the height of three or four feet.

P. parvifolia, *Nuttall*, 1. p. 256.

P. polygamum. *Vent. Hort. Cels.* p. 65.

Polygonella parvifolia. *Mich.* 2. p. 241.

Amyris **Floridana*, foliis ternatis, foliolis ovatis integerrimis obtusis glabris, floribus subpaniculatis, baccis subglobosis, basi attenuatis.

OBSERVATIONS.—A shrub six or eight feet high with a smoothish pale bark. Leaves ternate, petiolate, lucid and apparently sempervirent, reticulately nerved on either side, and crowded with fragrant resinous glands. Calix four-toothed, (corolla not seen.) Berries black, about the magnitude of black pepper, and very fragrant, containing a thin fragile nut inclosing a single seed with a greenish pulp. It is perhaps scarcely distinct from *A. maritima*, and in every respect but the pinnated leaves, like *Sloane's* figure, vol. I. t. 199. of *Terebinthus major*. We should also take it to be the *Amyris*, figured by *Catesby*, but for the perfect smoothness of the leaves.

ENNEANDRIA.

Laurus geniculata, *Mich.* 1. p. 244.

Eriogonum, tomentosum, *Mich.*

DECANDRIA.

Vaccinium. myrsinites. *Mich.* 1. p. 233.

Andromeda mariana. *Lin.*

A. marginata. *Duhamel.* *A. nitida*. *Mich.* 1. p. 252.

Kalmia hirsuta. *Willd.* sp. pl. 2. p. 601.

Monotropa uniflora. *Lin.*

Jussieua erecta. *Willd.* 2. p. 578.

Jussieua **tenuifolia*, foliis sessilibus linearibus glabris, floribus sessilibus octandris.

OBSERVATIONS.—This specimen, which is very imperfect, presents a longish slender branch with a few remote flax-like leaves and remote quadrangular capsules; it is suffi-

ciently distinct from the other species indigenous to the U. States.

Cassia nictitans. Willd.

Stellaria elongata. Nuttall's p. 289.

Limonia acidissima? Lin.

OBSERVATIONS.—Perhaps a distinct species. As the spines, or rather prickles, are by pairs. The leaflets are small, roundish-oval and crenated. It bears considerable resemblance to the figure in the *Flora malabarica* quoted for *L. crenulata*, but is in all probability a distinct species, and my specimen is too imperfect for description.

ICOSANDRIA.

Chrysobalanus oblongifolius. Mich. 1. p. 283.

Lythrum virgatum. Willd.

Sesuvium pedunculatum. Decandolle. Leaves linear-oblong. Anthers purplish red.

Aronia arbutifolia. Perssoon.

POLYANDRIA.

Befaria racemosa. Mich.

Helianthemum canadense. Willd.

Rhizophora mangle. Lin. *Cateshys Carolina*, 2. p. 63 t. 63.

Ascyrum amplexicaule. Mich. 1. p. 77.

Hypericum galioides. Willd.

H. sphærocarpum? Mich.

Magnolia glauca. B **pumila*, foliis ellipticis utrinque acutis.

OBSERVATIONS.—A dwarf variety not exceeding three or four feet.

Porcelia pygmæa. Persoon. 2. p. 95.

Clematis viorna. Willd. Sp. Pl. 2. p. 1288.

Cyamus luteus. *nelumbium luteum.* Willd.

DIDINAMIA.

- Dracocephalum virginianum.* Willd.
Hyptis capitata. Willd. Sp. Pl. 3. p. 84.
Hyptis spicata. Poiteau in Annales du museum. 7. p. 474. t. 28. f. 2.
 First found by Richard in the island of St. Domingo.
Calamintha caroliniana. *Thymus carolinianus.* Michx.
 2. p. 9.
Trichostema dichotoma. Lin.
Verbena caroliniana. Michx.
Lantana Camara. Lin.
Bignonia capreolata. Lin.
Ruellia strepens. Lin.
Buchnera americana. Lin.
Avicennia tomentosa. Willd.

OBSERVATIONS.—This shrub grows also around the Balize near the mouth of the Mississippi, where, as in Jamaica it is called mangle. The present plant agrees precisely with Sloane's figure, but is in all probability a distinct species from that of Rheed in the Flora malabarica, vol. 4. t. 45, in which the flowers are produced in longish pedunculated panicles, while in the present plant they are aggregated in almost sessile clusters. Besides which, the Avicennia of India is a stately tree, seventy feet high, and often sixteen feet in circumference, while the Floridian plant is merely a sempervirent shrub.

- Gerardia linifolia.* Nuttall's Genera. 2. p. 47.
Seymeria tenuifolia. Pursh. Flor. Am. 2. Suppl. p. 737.
Nuttall's Gen. 3. p. 50.
Pentstemon pubescens. Aiton.
P. lævigatum. Willd.
Schwalbea americana. Lin.
Orobanche americana. Lin.

TETRADYNAMIA.

- Arabis Canadensis.* Lin.
A. bulbosa. Willd.

Stanleya? amplexifolia, foliis integris? amplexicaulibus, floribus corymbosis siliquis nutantibus.

OBSERVATIONS.—Of this plant whose genus is consequently doubtful, we have seen only seedling specimens which Mr. Ware collected in the arid pine forests. The whole plant appears to have been smooth and glaucous, the stem terete, herbaceous, low, and branching towards the summit. With the radical leaves we are unacquainted, those few which remain on the stem are cordate-ovate, amplexicaule, and entire. The flowers have been aggregated in a close corymb; the peduncles are filiform. The siliques curved downwards, are conspicuously stipitate, flat, and two and a half to three inches long, the stipe about three fourths of an inch, with the peduncle somewhat shorter. The dissepiment is equal and parallel with the valves. The seeds are alternately attached to either side the suture of the dissepiment, and are small, brown, oval, striated and compressed. The cotyledones are simple or undivided, and the radicle curved.

MONADELPHIA.

Lobelia crassiuscula. Mich.

Lobelia **aphylla*, minima; caule filiformi subsimplici squamosa, pedunculis remotis elongatis.

OBSERVATIONS.—Found by Mr. Ware in shady swamps accompanying *Tripertella coerulea*, from which the dried specimens are scarcely distinguishable. Root perennial. Stems filiform, four to six inches high, generally simple, bearing from about one to five remote, long pedunculated flowers. Capsule elliptic-ovate.

Passiflora **Warei*, foliis inferioribus trilobis acutis, superioribus indivisis ovatis, petiolis, biglandulosis, pedunculis, subgeminis.

OBSERVATIONS.—Lower part of the stem suberose. Leaves smooth and shining, of a thin consistence, having short biglandular petioles, the lower ones two and three lobed, the upper simply ovate, all acute. Stipules none. Peduncles commonly a pair in each axill, about the

length of the petiole. The flowers are very small. The calix formed of consimilar ablong-linear segments. Filiform segments of the crown, (or lepanthium) few, and shorter than the calix. Berries about the size of peas, purple.

Oplotheca Floridana, *Nuttall's Genera* 2. p. 79.

Pistia spathulata. *Mich.*

Sida rhombifolia. *Wild.*

*Hibiscus *pentaspermus*, *H. Virginicus*. *Mich.* 2. p. 46.

OBSERVATIONS.—Leaves partly hastate, the lower ones subsessile. Flowers small, red, with a yellow base, partly disposed in irregular few-flowered racemes. Exterior calix. as usual multifid and filiform. Capsule hirsute, depressed, pentangular, five-celled, indivisible, each cell one-seeded. This species is nearly allied to *urena*. *Hab.* from Cape Henlopen to East Florida.

DIADELPHIA.

Petalostemon corymbosum. *Mich.*

*Petalostemon *roseum*, glabrum, foliolis linearibus, bracteis subulatis brevissimis persistentibus; calycibus striatis glabris.

OBSERVATIONS.—A species possessing very much the habit of *P. violaceum*, but with the calix perfectly smooth, and the petals of a rose colour.

Polygala pubescens. *Nuttall's Genera* 2. p. 87.

P. lutea *Wild.* *Sp. Pl.* 3. p. 894.

Erythrina herbacea. *Wild.* 3. p. 912.

Lathyrus palustris. *Wild.* 3. p. 1000.

Psoralea.

Lupinus diffusus. *Nuttall's Gen.* 2. p. 92.

Hedysarum paniculatum. *Wild.*

Æschynomene viscidula. *Mich.* 3. p. 74.

Sesbania platycarpa. *Persoon. Syn.* 2. p. 316.

S. Macrocarpa. *Nuttall's Gen.* 2. p. 114.

Glycine erecta. *Nuttall's Gen.* 2. p. 114.

G. caribaea. *Wild. Jacquin. Tc. rar.* 1. t. 146. *G. reflexa*. *Nuttall's Gen.* 2. p. 115.

Indigofera caroliniana. *Walter. Mich.* 2. p. 68.

SYNGENESIA—ÆQUALIS.

Prenanthes racemosa. Mich. 2. p. 94.

Prenanthes, *aphylla*, foliis paucissimis subulatis brevibus, caule simplici superne nudo; calycibus, multifloris.

P. Aphylla, *Nuttall's Genera*. 2. p. 123.

OBSERVATIONS.—Root perennial. Stem about two feet high striated, in the specimen under examination, producing but two subulate leaves near its base, the lower one about an inch and a half, the upper one less than half an inch; the rest of the stem perfectly naked, and producing two unequally pedunculated large pale rose red flowers; at the base of the stem there is a single sphacelous abortive scale; the calix is subtended by a considerable number of imbricated lanceolate scales. Florets about twelve ligulate, and twelve tubular.

Liatris graminifolia. Pursh. 2. p. 408.

L. elegans. Willd. 3. p. 1635.

L. tenuifolia. Nuttall's Gen. 2. p. 131.

L. paniculata. Willd. 3. p. 1637.

L. corymbosa. Nuttall's Gen. 2. p. 132.

Liatris * *oppositifolia*, foliis lanceolatis, sub oppositis nervosis, caule ramoso, ramulis paniculato-corymbosis, calycibus cylindraceo-ovatis parvulis sub 15—20-floris, squamis oblongis obtusis intimis, coloratis pappus scabriusculis.

Hab. discovered also near New-Orleans and communicated to me by Dr. Harlan, of Philadelphia.

OBSERVATIONS.—Root perennial? The whole plant pubescent. Stem terete, a little below the summit, oppositely branched, the branches corymbiferous. Leaves small, ovate-lanceolate, about three-nerved, on the branches sometimes alternate. Flowers small, resembling those of *L. paniculata*, but more numerous. Scales of the calix striate, unequal, the interior ones coloured and elongated. Pappus merely scabrous, not plumose.

Liatris * *fruticosa*, glabra; caule fruticoso, ramis corymbosis, foliis cuneato-obovatis punctatis, calycibus subquinquefloris, laciniis acuminatis.

OBSERVATIONS.—A brittle branched shrub with rather crowded leaves, shaped like those of common purslain (*Portulacca oleracea*), branchlets attenuated and almost, naked above. The calyx narrowed at the base, is formed of a few imbricated, linear-lanceolate, and acuminate scales, (in a dried state,) shining with resinous atoms as in the *Eupatoriums* Florets purple, the pappus also tinged with the same colour. The corymb of flowers in this species, with the exception of colour, could scarcely in any respect be distinguished from those of *Ruhnia Critonia*.

Eupatorium coelestinum. Willd.

E. foeniculacium. Willd.

Mikania scandens. Willd.

Polypteris integrifolia. Nuttall's Gen. 2. p. 139.

Melananthera hastata. Mich.

SYNGENESIA.—SUPERFLUA.

Baccharis halimifolia. Lin.

B. angustifolia. Mich. 3. p. 125.

Conyza pycnostachya. Mich. 2. p. 126.

Erigeron pusillum. Nuttall's Gen. 2. p. 148.

E. philadelphicum. Willd.

Inula (Chrysopsis) gossypina. Mich. 2. p. 122.

I. scabra. Pursh. 2. p. 531.

I. graminifolia. Mich. 2. p. 122.

I. divaricata. Nuttall's Gen. 2. p. 152.

I. obovata. Nuttall's Gen. 2. p. 152.

Aster montanus. Nuttall's Gen. 2. p. 156.

A. carolinianus. Walter. Willd. 2. p. 2017.

Solidago pyramidata. Pursh. 2. p. 537.

S. lacevigata. Willd. 3. p. 2063.

Selloa * *nudata*, radiis paucissimis, floribus corymbosis, bracteis filiformibus, foliis integerrimis linearibus oppositis glabris. *Hab.* East-Florida.

OBSERVATIONS.—Perennial ? Stem smooth and angular. Leaves opposite linear, rather thick and smooth. Corymb compound, trichotomous. Flowers yellow, scarcely distinguishable from those of *solidago*, except by the paucity of rays. Calyx five-leaved, cylindric, coloured. Rays often altogether wanting ? (in my specimen.) never more than

one. Florets five to eight. Pappus more. Seed smooth and black. The genus has been recently formed by Sprengel, and founded on Brazilian species. The present plant appears to be allied to *Chrysocoma*.

Boltonia asteroides. Willd. 3. p. 2162.

Eclipta procumbens. Mich. 2. p. 129.

Verbesina virginica. Willd. 3. p. 2222.

Tetragonotheca helianthoides. Willd. 3. p. 2116.

Bupthalmum frutescens. Willd. 3. p. 2229.

SYNGENESIA.—FRUSTRANEA.

Galaridia bicolor. Willd. 3. p. 2245.

Balduina multiflora. Nuttall's Gen. 2. p. 176.

Helianthus tracheliflorus. Willd. 3. p. 2241.

Rudbeckia hirta. Willd.

Bicleris chrysanthemoides. Willd. 3. p. 1717.

Actinomeris * *pauciflora*, foliis oblongis serrulatis decurrentibus nudis paucifloris.

OBSERVATIONS.—Stem apparently simple: Leaves opposite oblong or oblong ovate. Peduncle few-flowered, long and naked, (in my specimen, two-flowered. Calix composed of about a simple series of lanceolate leaves. Seeds winged on the margin, shortly two-horned. (Flowers not seen.)

SYNGENESIA.—NECESSARIA.

Silphium * *subacaule*, *scabriusculum*: caule brevissimo, pedunculis longissimis, foliis oblongis subsinuata-pinnatifidis dentatis, calycinis foliolis dilatatis rhomboideis.

OBSERVATIONS.—A species very remarkable for its diminutive stature, the stem being often altogether wanting, and at most but two or three inches high. Leaves sessile, alternate, two or three inches long, with the margin alternately sinuated so as almost exactly to resemble the leaves of some species of *Senecio*. Peduncle nearly a span long. Flowers, as usual, yellow. The seeds also conformable with the genus.

SYNGENESIA.—SEGNEGATA.

Elephantopus carolinianus. Willd. 3. p. 2390.

GYNANDRIA.

Maranta arundinacea, culmo ramoso herbaceo, foliis ovato-lanceolatis; floribus subpaniculatis.

M. arundinacea, canna cori folio; Mart. Cent. 39. t. 39.

Canna Indica, radice alba alexipharmica. *Sloane*. Jam. 1. p. 253. t. 149. f. 2. Representing merely the figure of the leaf, and says that it had been introduced into the island of Jamaica from Dominica. It is believed to be a native of South America.

Tc. Redoute's Liliacea. t. 57.

This plant was seen in extensive marshy fields by Mr. Ware, about the latitude of 28°, and agrees in every important particular with the officinal plant, except in the absence of hairs upon the leaves, the nodes are, however, pubescent. The fruit by abortion presents a round one-seeded nut.

Maranta arundinacea. B. *pumila*, culmo simplici, floribus fasciculato-paniculatis.

OBSERVATIONS.—Perhaps the mere autumnal shoots of the preceding; Mr. Ware, however, considered it as something distinct from its uniform dwarf habit.

Habenaria repens? *Nuttall's* Gen. 2. p. 190.

Cranichis multiflora. Elliot. *Nuttall's* Gen. 2. p. 191.

OBSERVATIONS.—Leaves nearly all radical, ovate, one or two however embracing the lower part of the stem. Upper part of the stem pubescent. Flowers greenish, somewhat remote, about twenty, more or less, forming a raceme four or five inches in length. Bractes ovate and acuminate of a sphacelous membranaceous consistence, and less than one half the length of the germ. Caternal segments of the corolla, ovate and oblique, connivent with the uppermost; innermost segments dilated, broader and nerved. Lip inverted or situated behind, unguiculated, the lamina concave, and abruptly acuminate. Column

or style concave nearly its whole length, including two? masses of sulphur yellow farinaceous pollen, the concavity or cell closed by a lanceolate oblong articulated operculum.

Triphora pendula, *Nuttall's Gen.* 2. p. 193.

Arethusa pendula. *Willd.*

Neottia tortilis. *Willd.*

N. cernua. *Willd.*

MONOECIA.

Urtica. Apparently new, but too imperfect for description.

Parietaria floridana. *Nuttall.* 2. p. 208.

Amaranthus pumilus. *Nuttall.* 2. p. 210.

Quercus virens. *Willd.*

Quercus laurifolia. *Willd.*

Q. maritima. *Willd.*

Q. imbricaria. *Willd.*

Carya aquatica. *Juglans aquatica*. *Michaux.* Arb. Forest.

Pinus palustris. *Willd.*

Acalypha caroliniana. *Willd.*

Croton maritimum. *Willd.*

C. glandulosum. *Willd.*

Ephorbia cyathophora. *Willd.*

E. maritima.

Jatropha manihot? *Lin.*

The celebrated root from which the Cassava bread is made, and which, according to Thenet, was used over an extent of two thousand leagues. Sloane also adds, "It is of the most general use of any provision all over the West Indies, especially the hotter parts, and is used to victual ships." *Hist.* 1. p. 130. The sap of the root, which in a raw state is poisonous, "evaporated over the fire, gives the Tapioca meal, and the leaves, when boiled, are eaten after the manner of spinach. Sloane's *Hist.* vol. I. p. 131. In the specimen collected by Mr. Ware, the lobes of the leaf instead of being simple are subdivided. It may still, however, be the same plant in a state of luxuriance.

Stillingia sylvatica. *Willd.*

Phyllanthus obovata. *Willd.* Apparently perennial by the effect of climate.

Forestiera ligustrina. *Poiret.*

Borya ligustrina. *Willd.*

DIAECIA.

Ceratiola ericoides. *Mich.* 2. p. 222.

Viscum verticillatum. *Lin.*

Iresine elatior. *Willd.*

Zamia integrifolia. *Mich.* *Willd.*

OBSERVATIONS.—The farina of the root of this plant is much esteemed as food by the Indians, appears to be but little inferior to the Arrow-root.

CRYPTOGAMIA.

Lycopodium alopecuroides. *Willd.*

Vittaria linearis. *Willd.*

V. angustifrons. *Mich.* 2. p. 261.

Osmunda cinnamomea. *Willd.*

Polypodium. A fragment of a very large species.

Aspidium.

MATHEMATICS.

ART. XIII.—*Review of the Cambridge course of Mathematics.*

1. An Elementary Treatise on Arithmetic, taken principally from the Arithmetic of S. F. Lacroix, and translated into English, with such alterations and additions as were found necessary in order to adapt it to the use of the American student. Second Edition, revised and corrected. pp. 128.

2. An Introduction to the Elements of Algebra, designed for the use of those who are acquainted only with the first principles of Arithmetic. Selected from the Algebra of Euler. Second Edition. pp. 216.

ERRATA IN MR. NUTTALL'S CATALOGUE.

(The Editor was out of town when this piece was struck off.)

- Pa. 237, line 7, from the top, for *quandripartitis*, read *quadripartitis*.
 20, " *pumilla*, read *pumila*.
 4, bottom, *rupous*, read *rufous*.
 238, 13, from top *Cenococephala*, read *Leucocephala*.
 2, from bottom, *Browner*, read *Brownei*.
 1, " *Diadia*, read *Diodia*.
 239, 3, from top *Ludiwigia*, read *Ludwigia*.
 22, " *Ipomao* read *Ipomoea*.
 " *obicularis*, read *orbicularis*.
 25—26, " *T.* read *I.*
 At the bottom of the page after "aspect," read *instead of*
 290, 2, from top, for *The* read *the*.
 21, " *V.* read *O*.
 292, 23, " *St.* read *H*.
 6, from bottom, *acc.* read *occ*.
 2, " *surpuraceous*, read *furfuraceous*.
 294, 11, from top, *ris*, read *sis*.
 295, at bottom, *nelumbium*, read *Nelumbium*.
 296, 11, from top *Jamai*, read *Jamaica*.
 297, 13, from bottom, *Triperitella*, read *Tripterella*.
 6—7, after *petiolis* and *pedunculis*, dele
 298, 3, from top *ablong*, read *oblong*.
 299, 17, " 408, read 508.
 300, 11, " *Ruhnia*, read *Kuhnia*.
 31, " *locevigata*, read *lævigata*.
 302, 3, " *sprengel*, read *Sprengel*.
 11, " *tracheliflorus*, read *tracelifolius*.
 12, " *biclens*, read *bidens*.
 302, 2, " *Segnegata*, read *Segregata*.
 5, from bottom, *Cateral*, read *lateral*.
 303, 24, from top, *Ephorbia*, read *Euphorbia*.
 304, 4, " *Diaecia*, read *Diacia*.
 10, " after *Indians*, read *and*.
 16, " for *cinnamonea*, read *cinnamomea*.
 17, " *Polypodicum*, read *polypodium*.

3. *Elements of Algebra*, by S. F. Lacroix. Translated from the French, for the use of the students of the University at Cambridge, New England. Cambridge, N.E. Hilliard and Metcalf, 1818. pp. 263.

M. Lacroix, the author of the first and third volumes before us, has long been distinguished as a writer upon the pure mathematics. His mathematical works commence with common arithmetic, and end only with the highest point, to which the science of calculation has been carried. Most of his treatises have passed through many editions, and are generally used in France, both for public and private instruction. They are connected with each other by references, a circumstance which adds greatly to the convenience and facility of reading them; and they are probably more complete, and of a higher scientific character, than any other course, which has hitherto been published. His *Arithmetic* and *Elements of Algebra*, form the two first volumes of his course, and of these it will be our duty soon to speak particularly. His third volume is upon the *Elements of Geometry*. This is followed by an elementary treatise on rectilineal and spherical Trigonometry, and on the application of Algebra to Geometry, and by supplements to the elements of Algebra and Geometry. This last supplement is a treatise upon Descriptive Geometry, a branch of Mathematics which has been recently opened, or rather which has recently been reduced to rigorous principles, and been used as an instrument of investigation. It has not been much cultivated out of France.* It was established as a branch of instruction in the Normal School, created by a law of 30th October, 1794, and three Professors were appointed for the object, among whom was M. Lacroix.

Descriptive Geometry has two objects; the first is, to represent with exactness, upon surfaces which have but two dimensions, objects which have three dimensions, and which are susceptible of a rigorous definition. Under this point of view, it is a language more perfect than any other

* We observe with pleasure, that Mr. Croyt, Professor of Engineering in the Military Academy of the United States, has published the first part of a treatise on Descriptive Geometry, for the use of the Cadets of that institution.

for communicating every thing capable of delineation or construction, and particularly forms the foundation of the graphic arts. Its second object is, to deduce from the exact delineation of objects, every thing which results from their respective forms and positions. In this way, as it offers continual examples of passing from what is known to what is unknown, it becomes an instrument of investigating new truths. The most complete work on this subject, we believe, is, Monge's *Géométrie Descriptive* with M. Hachette's supplement.

The next volume of M. Lacroix's course, is an elementary treatise on the differential and integral calculus, of which a translation was some years since published in England. Then comes an elementary treatise, on the calculation of probabilities. The course concludes with a volume consisting of *Essays on Instruction* in general, and on that of the mathematics in particular; or the method of studying and teaching mathematics. This volume, we hesitate not to say, contains views of study and instruction of the very first importance, founded on a knowledge of the human mind, and on experience gained by directing the studies of a great number of young men, during a long course of years. It also sheds much light on many parts of the other volumes which compose the course, and we shall often have occasion to refer to it in the course of the present article.

The principal remaining work of Lacroix, is his "*Traité du Calcul Differentiel, et du Calcul Integral*," 3 Tom. 4to. In this work, he professes to have collected and systematically arranged whatever is most valuable in the treatises of Euler, Lagrange, &c., and in the numerous analytical memoirs scattered through the volumes of the different learned societies and academies of Europe. This vast quantity of materials, receiving from the vigorous and systematic mind of Lacroix uniformity of style and development, is incorporated into one great work, every part of which is impressed with the genius and luminous views of the author, and from which a knowledge of the transcendent analysis, in its present improved state, can be obtained.* (*Edinb. Encyc.* vol. IX. 116.) While this treatise was in preparation, the author received a letter from the celebrated Laplace, of which the following is an extract. "*Je vois,*"

says he, "avec beaucoup de plaisir que vous travaillez à un grand ouvrage sur le calcul integral.....Le rapprochement des Méthodes que vous comptez faire, sert à les éclairer mutuellement, et ce qu'elles ont de commun renferme le plus-souvent leur vraie métaphysique; voila pourquoi cette métaphysique est presque toujours la dernière chose que l'on découvre. L'homme de génie arrive comme par instinct aux resultats; ce n'est qu'en réfléchissant sur la route que lui et d'autres ont suivie, qu'il parvient à généraliser les Méthodes, et à en découvrir la metaphysique."

As a mathematical writer, Lacroix appears to have formed himself on the model of Clairaut and Euler. In clearness and eloquence, he falls not much below the latter, and in the profoundness, extent and originality of his views, he is certainly inferior to neither. He is never a servile imitator of any of his predecessors. Although he freely makes use of their writings when they are to his purpose, yet whatever he takes from them, receives a new and original character from the view which he takes of it, and from the additional development which it often receives from him.

Of Euler it is not necessary to say much, to those who are, in any degree, acquainted with mathematical science. In clearness and elegance of demonstration and illustration, he stands the prince of mathematicians, and in fertility of invention, he has never been surpassed. He is author of more than thirty separate works, and of nearly seven hundred memoirs, most of which are to be found in the volumes of the Academies of Berlin and St. Petersburg.* (Condorcet, *Eloge de M. Euler.*) Again, says the Marquis de Condorcet, "tous les mathématiciens célèbres qui existent aujourd'hui sont ses élèves. Il n'en est aucun qui ne se soit formé par la lecture de ses ouvrages, qui n'ait reçu de lui les formules, la méthode qu'il emploie, qui, dans ses découvertes ne soit guidé et soutenu par le génie d' Euler."

The three volumes before us, are a part of the course of mathematics, which is preparing under the direction of Professor Farrar, for the use of the students of the University in Cambridge. The two first are required to be studied before admission, the last is a text book in the university course of instruction. Three other volumes have appeared, two on the pure, the other on the applied mathematics ;

and these, we learn, are to be followed by others on the applied mathematics, making a complete course.

A course of mathematical instruction, and, indeed, a course of instruction of almost any other kind, may be considered in two points of view ; first in relation to the development of the faculties of the mind, and secondly, as furnishing results to be used for the practical purposes of life. Each of these objects is important, and both ought to be united, as far as possible, in a course of public instruction. The practical purposes to which mathematical learning is applied, are by no means few, nor of inconsiderable value. Commercial and political arithmetic, have the most important connexions with mercantile transactions, with practical legislation, and with the science of government. Mathematical principles form the basis of Geography, in determining the figure and dimensions of the earth, the situation of places upon its surface, &c. ; of History, as connected with the chronology of events, &c. ; of Surveying, in which boundaries are to be traced, estates, provinces, canals, &c. laid out ; of Navigation, in which the course, latitude, longitude, &c. are to be determined ; of Architecture in which the strength of timber, the pressure upon each part, the best form of arches, &c. are to be calculated ; of Mechanics, in which the laws of motion, the composition of forces, the structure and equilibrium of machines, &c. are to be estimated ; of the science of War, in the planning of fortifications, in the theory and practice of gunnery, &c. ; of Optics, in explaining the laws of vision, in the theory of colours, and of the rainbow, and in the construction of optical instruments, &c. ; of Astronomy, in calculating the effects of that most extensive of all principles with which we are acquainted, the law of gravitation, upon the solar system, &c. ; of Music, in the propagation and comparison of sounds, in the theory of tones as connected with vibrations, &c. ; of the crystallo-graphic part of Mineralogy ; of Chemistry, especially in the doctrine of multiple proportions ; and in fine, of a great part of the whole circle of arts and sciences.* (Pres. Day's Algebra, p. 6.)

But it is particularly with a view to the development of the mental powers, that a course of mathematics is important. Granting, if it is possible, that the Physician, the Divine, the Advocate, or the Judge, may have forgotten eve-

ry proposition in Geometry, and every principle in Algebra; still he may be indebted to these sciences learned in early life, for no small part of his skill in separating error from truth, for his power of fixed attention, for his caution in admitting proof and in drawing conclusions, for the general discipline of his mental faculties, and his capacity for arranging all the parts of a long argument, so that it may result in the clear establishment of the desired truth. Such a habit of mind constitutes *true learning*, a rare acquirement; and ought to be the ultimate object of every system of education. It is capable of application to every subject, at all times, and in every situation. Without the accomplishment of this object, no education can be in a considerable degree complete, much less can the mind be highly cultivated.

It may be interesting to know the views of Lacroix in composing his course, and the principles by which he was guided. "Having been from early life," says he,* (*Essais sur l'enseignement*, p. 171,) "engaged in the labours of instruction, I always turned my attention upon the means of presenting the results of science by the most simple methods, (*par les faces les plus simples*,) and in the most natural order. With this view, I originally conceived the design of embodying in a series of volumes, all the materials of Geometry and of the transcendent analysis. Called to the functions of a professorship, which before I had performed only in schools, in which the form and matter of the instruction were rigorously fixed, and that of the Central Schools being left entirely at the disposition of the master, I was led by this liberty to reflect upon the means of perfecting the course which had been entrusted to me. I tried experimentally, upon a numerous class, (*auditoire*) the principles and the methods which I had conceived; their application served to confirm them, or sometimes modified them for the better."

Again, "teaching the sciences," says he,* (*idem* p. 173) "is subject to the same rules as that of the arts; the choice of examples is much more important than their numbers, a few truths thoroughly investigated, throw much more light upon the true method of procedure, than a great number of theories discussed in an incomplete manner. The first cast their roots deep, which cannot fail to spread themselves,

and from which spring trees whose numerous branches are loaded with fruit ; the others, which have scarcely pierced the ground, soon disappear, after having offered a sterile aliment to vanity."

To speak more particularly, M. Lacroix appears to have been governed in preparing his mathematical works, by the following principles :—

1. To give a demonstration as rigorous as the nature of the case would admit, of every rule and principle of which any use is made. This is very different from the course pursued in *most American and English* books upon mathematics. In our treatises upon Arithmetic and Algebra, with a very few honourable exceptions, the rules are given in a very concise and purely didactic form, and whatever attempt there is at an investigation of them, is thrown into notes which are seldom much consulted. Nor is the student generally in blame for not consulting them, as they are usually so ill adapted to the state of his knowledge, that he finds it impossible to understand them. In Dr. Hutton's "course of mathematics," which will be admitted to be a pretty fair example, the rules of Arithmetic are demonstrated by algebraic methods, and the rules of algebra are usually without demonstrations. Now, by Lacroix and Euler, on the contrary, every thing is demonstrated in as rigorous a manner, as the state of the student's information will warrant. He sees at each step, the ground on which he is proceeding, and forms from the beginning, a *habit* of demonstration. The greatest part of the mathematical learning among us, we believe, is not much unlike that of the mere practical navigator, who knows what his book says, and how to apply what it says, but who is in Egyptian darkness with respect to the reason upon which any thing is said. A young man who accustoms himself from the first, to demonstrating every thing which he receives as truth, and to developing fully the conditions expressed or implied, of every problem which he solves, will soon form a habit of researches of this kind. Such a habit constitutes true knowledge in mathematics, and will furnish resources for unexpected cases where no rules are provided, or where a new combination of them is required ; and where the mere mechanical calculator would find himself totally unable to proceed. But what is above all price, such a course most

effectually prepares a young man to pursue a course of discovery of his own, after becoming so thoroughly acquainted with the discoveries of others.

2. He avoids repetitions. (*les doubles emplois** *Essais* p. 180.) This becomes so much the more necessary, as the recent progress of the mathematical and physical sciences has greatly increased the mass of objects of instruction. He seldom employs different demonstrations to come to the same result; and never, unless it be in a succeeding part to give a more rigorous demonstration to a principle of extensive use which could not at first be demonstrated in a rigorous manner; or unless the second demonstration gives him occasion to make some new remark, or deduce some interesting principle.

3. He always chooses the most general methods. This rule is in some degree a consequence of the former, since by means of such methods, repetitions are most effectually avoided. "In instruction," says Laplace, "prefer general methods, take care to present them in the most simple manner, and you will find at the same time, that they are always the most easy."* (*Essais* p. 181.) It is time to distrust this predilection for particular methods, under the idea that they are more elementary than general methods; whereas the truth is, that they are preferred because more ancient, and more agreeable to habits previously acquired, and which are not easily reformed. It is erroneous and contrary to established experience, to suppose that general methods must be preceded by an exposition of particular methods. General methods have no need of any assistance of this kind, when they are suitably explained, and do not meet, *in the minds of those who study them, or judge of them*, with old ideas to be effaced, or old prejudices to be destroyed. If we prefer the synthetic methods, because we think them attended with more complete evidence, and that they speak more to the senses; we must recollect that the analytical methods are vastly more fertile, and that the writings of the great mathematicians of our age, are composed in the style of these methods which it is absolutely necessary to study, as soon as we rise above the elements.* (*Essais* p. 183.)

4. He makes use, as far as possible, of the analytic method. This method has been the great instrument of invention at all times in mathematical science, and has

certainly been too much neglected both in this country and in Great-Britain. This is best accounted for, perhaps, from the circumstance, that Sir Isaac Newton, from partiality to the ancient writers, delivered his splendid discoveries by the synthetic method,* and that his authority has influenced the greatest part of mathematicians who have written in his native language. The essential character of the synthetic method, is, that it always proceeds from the simple to the more complex, and is on that account well adapted to the communication of truth when once discovered. But it fails almost entirely in communicating to the mathematical reader, that spirit of invention, which may enable him, after perusing what is most valuable in the writings of others, to open a new track for himself. It seems particularly appropriate, that Algebra which is scarcely more than another name for Analysis,† should be communicated by the analytic, and not as has usually been done among us, by the synthetic method.

5. The treatises in question are so composed as to be preparatory and introductory to the higher and more difficult physical, astronomical and mathematical treatises. This circumstance can be no disadvantage to him who does not expect to pass the limits of the elementary part of the science, while it is of the utmost value to every one who designs to devote a considerable part of his life to mathematical learning. Such an one, is anxious to press forward to the works of the great masters of the science, and ultimately, if possible, to an acquaintance with the “Méca-

* Sir Isaac Newton appears originally to have made his discoveries by analysis, and afterwards, in communicating them to the world, to have clothed them with a synthetic demonstration, with a view to render them more fit to meet the public eye; he thus expresses himself in his treatise of Fluxions: *Postquam area curvæ alicujus ita (analyticè) reperta est et constructa, indaganda est demonstratio constructionis, ut omisso, quatenus fieri potest, calculo algebraico, theorema fiat concinnum et elegans ac lumen publicum sustinere valeat.* Newtoni opuscula, vol. I. p. 170.

M. Laplace thinks that Newton had found the greatest part of his theorems by analysis, but that his predilection for synthesis, and his great esteem for the geometry of the ancients, made him deliver, under a synthetic form, his theorems and even his method of fluxions. *Exposit. du Syst. du Monde* 4th edit. p. 422.

† Some writers on mathematics make a distinction between analysis and algebra. Bezout defines analysis to be the method of determining those general rules which assist the understanding in all mathematical investigations, and by Algebra, the instrument which this method employs for accomplishing that end. Euler's Alg. 2d edit. London. p. 3.

nique analytique" of Lagrange, and the "*Mécanique céleste*" of Laplace, which, doubtless, at present, form the limit to which human ingenuity and mental power have been extended. By having elementary works composed with reference to the higher books, and leading naturally to them, much of the strength of an enterprising scientific man will be spared, and reserved for some other valuable purpose, which would, otherwise, be exhausted and mispent upon treatises less fitted to guide him safely to his ultimate object.

We now proceed to notice particularly the volumes before us. It is important to remark, that the arithmetic will be of little advantage to any, who are determined not to take the trouble of thinking, and who have nothing of the spirit of enquiry and investigation. At the same time the book is calculated to awaken and cultivate this spirit. The author first occupies himself with some general remarks on the different kinds of magnitude or quantity, on the proper idea of number, and on the natural mode of forming numbers. From the observation, that there are no limits to the extension of numbers, he takes occasion to explain in a very luminous manner, the construction of the numerical nomenclature, by which numbers to any extent, are expressed by a small number of terms. This, again, gives him opportunity to illustrate the written numeration, and the fundamental law of it, "that a removal of one place towards the left, increases the value of a figure ten times." This method of expressing all numbers with ten characters, by giving them at once an absolute and a local value, is extremely ingenious, and appears to have originated in India.* (*Laplace, Syst. du Monde, p. 363.*) It is from this construction, that the extreme facility of all our arithmetical calculations is derived, by which the modern system of arithmetic is rendered so much superior to the ancient. We shall have some idea of the merit and difficulty of the invention, by considering that it escaped the genius of Archimedes and Apollonius, two of the greatest men of antiquity. There is a verbal difference between enumeration as given by Lacroix and other French writers, and as stated in English and American arithmetical books. In both methods of reading numbers, the seventh figure from right to left, is denominated millions. In the English method, the 13th figure is billions, the 19th trillions, and every addition of six places, receives a new denomination, while in

the French method, the 10th figure is the place of billions, the 13th of trillions, and each succeeding addition of three places, gives a new denomination.*

Fractions are introduced immediately after division, and are very naturally considered as deriving their origin from imperfect divisions. He explains the changes which a fraction receives from operations performed upon its numerator and denominator; and in this way collects a few principles upon which the whole theory of fractions is made to depend. Indeed, these principles might be reduced to one, were it not that the subject would thus be rendered unnecessarily and unprofitably abstract.

A circumstance over which the greatest part of authors have passed too superficially, is, the application of the definitions of multiplication and division relative to whole numbers, to fractions. These definitions applied to whole numbers, comprise only the most simple cases of the operations which they express, while as applied to fractions, the terms multiplication and division have a general acceptation, in which new cases are comprised, connected with the first only by simple analogies. Our author has, therefore, given new definitions of multiplication and division, which appear a little abstract before reflection, but which are applicable to all possible cases of these operations. By this instance, also, the student is taught in a striking manner, the signification of the term generalization in mathematical and philosophical writings.

The complication which the diversity of denominators introduces into operations by common fractions, leads naturally to the invention of decimal fractions, which removes this complication. Decimal fractions are therefore, here introduced in the order of invention. The student is prepared by his own experience of the inconveniences attached in practice to the use of vulgar fractions, to seize completely the advantages of the decimal system, although this system generally gives only approximate instead of rigorous values. This disadvantage, however, of the decimal sys-

* The French method of estimating numbers is adopted in the *Art. Arithmetic of the Edinb. Encyc.* as being less complicated than the English method. As the difference between the two methods is only in the higher denominations, which seldom occur, the difference for practical purposes will not be great.

tem is almost nothing in practice, as the approximations may be carried to any required degree of exactness.

In the translation, reduction and the rules for compound numbers are written anew, and adapted to our system of weights and measures. This was necessary, because the original was prepared with reference to the new French metrical system, the construction of which is strictly decimals. Proportion is illustrated with admirable clearness, and is freed from several distinctions made in the common books, which serve only to embarrass the learner. The rule for compound proportion, as generally given, is applicable only to questions containing five terms, whereas Lacroix has investigated a rule which extends to questions containing any number of terms.

With all its merits, we think this treatise of arithmetic is not without its defects. It would be more useful for practical, and not less so, for theoretical purposes, if it contained a few more applications to classes of questions arising from the social and commercial relations of man. The translation is in this respect somewhat less valuable than the original, as this contains a short article on the application of arithmetic to banking and commerce. But even the original is not sufficient. We know very well, that all these questions belong to proportion or fractions, and cause no possible difficulty to one theoretically acquainted with the subject, but practical men are guided very mechanically by rules, and are immediately alarmed and embarrassed if they are obliged to depart in the least from acquired habits. At page 65, on American money, the statute of the Old Congress of Aug. 1786, is referred to, instead of the Act of April 1792, by which the mint of the United States was established on its present foundation. The note upon the same page, is almost entirely wrong, as will appear from a comparison of it with what follows, which is taken from the statute above referred to, and which furnishes a part of the materials, of which such a note ought to be composed. By this act, Eagles, half-Eagles, and quarter-Eagles in gold; dollars, half-dollars, quarter-dollars, dimes and half-dimes in silver; and cents and half-cents in copper; are the established coins. The standard for gold coins only, is eleven parts fine, and one part alloy. The standard for silver coins, is, 1485 parts fine to 179 parts alloy. The alloy in the gold coins is a mixture of silver and

copper, not exceeding one half silver; in the silver coins, the alloy is entirely copper. The weight of fine gold in the Eagle is 247.5; of standard gold, 270. The weight of fine silver in the dollar, is, 371.25 grains; of standard silver, 416 grains. All coins, inferior to the Eagle, and dollar, contain a quantity of pure metal and alloy, proportional to their denominations. The proportional value of gold to silver is established by law to be in the ratio of 15 to 1.

In page 78, the franc is valued at \$0.1796, which does not agree with its value as obtained from the value of the Napoleon, or piece of 40 francs given in the table on the last page, and neither of these values agrees with that obtained from the five franc piece, which was declared by an act of Congress of April 1816, founded, we understand, on the report of the Assayer of the mint, and which is now in force, to be 93 cents and 3 mills.

The last 50 pages of the original, are omitted by the translator, as they consist mostly of tables for converting the old French measures into the new, and the reverse; and of other subjects of local reference. Two articles in this part, however, ought certainly to have been retained; one on the decomposition of a number into its factors, and the other, on the nature and summation of a numerical continued fraction. The former is often of great practical utility, and the latter is indispensable to the completeness, and even to the consistency of the course, because in Legendre's geometry, which forms the fourth volume of it, in investigating the approximated ratio of the diagonal to the side of a square, the student is required to sum up a continued fraction, for which no means are furnished him.

As the summation of a continued fraction is necessary to the course, and not to be found in any of our arithmetical books, we shall give a translation of M. Lacroix's article on the subject, for the benefit of those readers, who may not have a copy of the original at hand.

"When we are conducted by a calculation to a fraction whose numerator and denominator are pretty large, and have no common factor, we seek approximate values of this fraction, which are expressed by more simple numbers, with a view to form a more exact idea of it.

If we have for example the fractional number $\frac{1103}{117}$, we obtain, at first, the whole number, and there results 1 and

$\frac{2}{3}\frac{1}{4}$. Now, to form a more simple idea of the fraction $\frac{2}{3}\frac{1}{4}$, we endeavour to compare it with a part of unity, that we may consider but one term, and for this we divide the two terms by 216; we find 1 for the quotient of the numerator, and $4\frac{2}{3}\frac{3}{8}$ for that of the denominator; this last quotient, which is contained between 4 and 5, shews also that the fraction $\frac{2}{3}\frac{1}{4}$ is between $\frac{1}{4}$ and $\frac{1}{3}$. By stopping at this point, we see that the second approximate value of the expression $\frac{1}{8}\frac{9}{16}$ is 1 and $\frac{1}{4}$, or $\frac{5}{4}$. But this value is too great, for the true value would be equal to 1 plus 1 divided by 4 and $\frac{2}{3}\frac{3}{8}$, which is written thus: $1\frac{1}{4\frac{2}{3}\frac{3}{8}}$.

To form an exact idea of the expression $1\frac{1}{4\frac{2}{3}\frac{3}{8}}$, it is necessary to consider it as indicating the quotient of the whole number 1 divided by the whole number 4 accompanied by the fraction $\frac{2}{3}\frac{3}{8}$.

If we divide the two terms of $\frac{2}{3}\frac{3}{8}$ by 23, the quotient will be $\frac{1}{9\frac{9}{23}}$; neglecting the $\frac{9}{23}$ which accompany the whole number 9, there will be $\frac{1}{9}$ only instead of $\frac{2}{3}\frac{3}{8}$, and consequently, $1\frac{1}{4\frac{1}{9}}$ will a third approximate value of $\frac{1}{8}\frac{9}{16}$, a value which will be too small, since 9 being less than the true quotient of 216 by 23, the fraction $\frac{1}{9}$ will be greater than that which ought to accompany 4, and consequently the division $4\frac{1}{9}$ will be greater than the exact division $4\frac{2}{3}\frac{3}{8}$, and the quotient $\frac{1}{4\frac{1}{9}}$ smaller than the true quotient.

By reducing the whole number 4 with the fraction which accompanies it, and performing the division according to the process of Art. 80, we obtain $\frac{9}{37}$; and we have 1 and $\frac{9}{37}$ or $\frac{46}{37}$ for the third approximate value of $\frac{1}{8}\frac{9}{16}$.

The exact expression of this value being $1\frac{1}{4\frac{1}{9\frac{9}{23}}}$, if we divide the two terms of $\frac{9}{23}$ by 9, we shall have $1\frac{1}{4\frac{1}{9\frac{1}{3}}}$, neglecting the fraction $\frac{1}{3}$, there will remain $1\frac{1}{4\frac{1}{9}}$, a value

too great; for the fraction $\frac{1}{9}$ being greater than $\frac{1}{2\frac{1}{3}}$, whose place it occupies, will form, by being joined with 9,

a denominator too great, the fraction joined to 4 will consequently be too small, and the last denominator being too small, will render the last fraction too great.

By reducing, at first, $9\frac{1}{2}$ to a fraction, we have $\frac{19}{2}$; $\frac{1}{9\frac{1}{2}}$ will be then $\frac{2}{19}$, and the approximate value will become $1\frac{1}{4\frac{2}{19}}$; now $\frac{1}{4\frac{2}{19}}$ gives $\frac{19}{17}$, which joined to unity becomes $1\frac{19}{17}$, or $\frac{36}{17}$ for a fourth approximate value of $\frac{119}{17}$.

Resuming the expression, $1\frac{1}{4\frac{1}{9\frac{1}{2\frac{1}{5}}}}$, we divide the two terms of the last fraction $\frac{1}{5}$ by 5, and obtain $1\frac{1}{1\frac{1}{5}}$, and

$1\frac{1}{4\frac{1}{9\frac{1}{2\frac{1}{5}}}}$
 $2\frac{1}{5}$; neglecting the fraction $\frac{1}{5}$, there will remain $1\frac{1}{4\frac{1}{9\frac{1}{2\frac{1}{5}}}}$
 $2\frac{1}{5}$; and we see as above, that this value is smaller than the true value.

The fraction $\frac{1}{2\frac{1}{5}}$ reduces itself to $\frac{5}{11}$; and since the preceding $\frac{1}{9\frac{1}{2}}$ gives $\frac{2}{11}$, the next preceding becomes $\frac{1}{4\frac{2}{11}}$, equal to $\frac{11}{7}$; so that the fifth approximate value is $1\frac{11}{7}$, or $\frac{18}{7}$.

Dividing, finally, by 4 the two terms of the fraction $\frac{1}{4}$ which was neglected above, we have for a quotient $\frac{1}{1\frac{1}{4}}$; and by suppressing the fraction $\frac{1}{4}$, we obtain the new value

$1\frac{1}{4\frac{1}{9\frac{1}{2\frac{1}{5}}}}$
 $1\frac{1}{4}$, greater than the true value. If we reduce, successively, all the denominators to a fraction, to obtain the simple fraction which it represents, we shall find $1\frac{47}{18}$ or $\frac{65}{18}$. By restoring the fraction $\frac{1}{4}$ to the side of the last denominator, we form the expression $1\frac{1}{4\frac{1}{9\frac{1}{2\frac{1}{5}}}}$

$1\frac{1}{4\frac{1}{9\frac{1}{2\frac{1}{5}}}}$
 $1\frac{1}{4}$, which being reduced as the preceding, reproduces the fractional number $\frac{65}{18}$.

We may pursue the same process with any other fraction, and obtain a series of approximate values, alternately greater and less than its true value, if it is a fraction properly so called, or alternately less and greater, if as in the preceding example, the numerator exceeds the denominator.

The developments which I have now found for the expression $\frac{11}{13}$ are called *continued fractions*, which may be defined in general thus:—*Fractions whose denominator is composed of a whole number and a fraction, which fraction has for a denominator also a whole number and a fraction, &c.*"

Of the introduction to the elements of Algebra taken from Euler, much need not be said. The original treatise of Euler especially with Lagrange's additions, is very extensive, and is certainly one of the most luminous and complete treatises that have ever been written, and of course, any selection from it must partake of the merits of the original work. But as is always the case in such selections, the parts selected are not perfectly adjusted to each other, which gives rise to some abrupt transitions. It forms no necessary part of the course, and may be read previous to Lacroix's Algebra, or may be passed over without any other inconvenience than the necessity of dwelling somewhat longer upon Lacroix. It is, it must be confessed, read with more facility than Lacroix's, and is exceedingly well adapted to primary instruction. But we do not know that any point is explained by Euler which is neglected by Lacroix, much less that any one is better explained. The selections here published, comprise the greatest part of Euler's first volume, and are made from a translation published in England.

The Algebra of Lacroix next claims our attention. He introduces his subject by some preliminary remarks upon the transition from Arithmetic to Algebra, which are followed by observations on its nature and object. Several problems involving an equation are first solved entirely by common language, for which algebraic signs are immediately substituted, and the solution performed by means of them. In this way, the reason of the employment of Algebraic signs is from the first clearly made known, their utility and necessity become manifest, and Algebra is shewn to be a branch of universal language, differing from common language principally in the circumstances, that every sign has an invariable meaning, that it is of a far more ab-

stract character, and that it is infinitely more concise, which properties enable the calculator by a glance of the eye, to comprehend all the conditions, relations and consequences of the most complicated and bewildering enunciation. The learner is here, likewise, instructed in translating an enunciation from common to algebraic language, and vice versâ; and in the nature and use of *general formulas* as independent of particular problems, and as merely *indicating* operations to be performed upon numbers in order to find the numerical results belonging to any problem whose solution is required. This, if the student has vigour of mind sufficient to grasp the idea in all its extent, will forever remove the difficulties arising from the general and abstract nature of algebraic expressions, a difficulty which must be fully overcome by him, before his path in this science will be luminous, or even in a considerable degree free from embarrassment.

Our author next introduces the resolution of equations of the first degree with one in known quantity. We have heard him complained of for this early introduction of equations, but when we reflect, that equations are involved in one shape or another, even in the most simple arithmetical calculations, and that his early discussion of them gives rise to some remarks which throw much light upon the succeeding parts, we cannot consider his arrangement erroneous. Considering addition, subtraction, multiplication and division only as operations *analogous* to the like arithmetical operations, and presenting them in a point of view highly interesting, he has removed all the difficulty relative to the doctrine of plus and minus quantities, which is generally to beginners, so much a source of embarrassment and discouragement. In the investigation of the greatest common divisor of two expressions, his method will be found far more complete than those in common treatises, as must be evident to every one who will take the trouble of a comparison. In particular, the artifice of expunging from one of the expressions, any factor or factors not entering into all the terms of the other expression; and on the other hand, of introducing into one of the expressions, a factor not contained in all the terms of the other, is illustrated from the theory of multiplication in a very elementary manner. These improvements in the investigation of the greatest common divisor are the more valua-

ble, on account of its connexion with the solution of equations of the higher degrees.

After disposing of fractions, he resumes equations of the first degree, and discusses those cases in which two or more unknown quantities enter into them. This he does, by resolving several problems at great length, and seizing every opportunity that is presented, in the progress of the solution, to give important theoretical and practical instruction. In this way, he takes occasion to explain the nature of insulated negative quantities, (what was shewn before under the simple rules, having related to negative quantities combined in expressions with positive,) and he has demonstrated, *a priori*, that they follow the same rules as other quantities. This was necessary, as the theory of negative quantities is, at the same time, one of the most important and difficult of Algebra, and ought, therefore, to be established by rigorous reasonings. Indeed, it appears from the history of Algebraic science, that this theory especially in what relates to negative solutions of problems, was but little understood before the time of De Cartes.* (Essais, 258.)

The signification of the phrase *infinite quantities* in mathematics, is deduced from a fractional expression in which the numerator remains constant, while the denominator is continually diminished. The ultimate point towards which this diminution advances is zero, whence the expression $\frac{m}{0}$ is naturally the symbol of infinity; and mathematical infinity is a negative idea, and signifies merely the exclusion of all *limit* either in smallness or greatness. We arrive at the idea, therefore, by a series of negations, and infinity is that of which we affirm the limits cannot be attained by any conceivable magnitude whatever it may be.* The

* Assez souvent, says Lacroix, on a substitué le mot *indefini* au mot *infini*, croyant par là éluder les difficultés que faisait naître ce dernier; mais je ne vois en cela qu'une faute d'expression; car l'*indefini* peut avoir des limites, mais on en fait abstraction pour le moment, tandis que l'*infini* est nécessairement ce dont on affirme que les limites ne peuvent être atteintes par quelque grandeur concevable que ce soit." *Traité du calc. Diff. &c.* Pref. xix.

Another way more plain but less rigorous, of obtaining the idea of infinity given above, is this; any quantity m divided by a quantity much smaller than itself, gives a quotient much greater than itself, whence since the values of fractions whose numerators are constant, are inversely as their denominators, m divided by a quantity *very small*, will give a quotient *very large*; therefore, m divided by zero, gives a quotient greater than any finite quantity.

symbol of an indeterminate quantity is $\frac{0}{0}$, and an elementary method is given, of ascertaining the true value of expressions which appear to be indeterminate. The general methods of finding the true value of such expressions, belongs to the higher algebra. Equations of the first degree are concluded by an investigation and application of general formulas for their solution, after the manner of Bezout.

The extraction of the square root both of entire and fractional numbers, is next introduced, as this operation is necessary and preparatory to the solution of equations of the second degree. The exposition of the method is founded on the composition and analysis of the formula $a^2 + 2ab + b^2$, in which a represents the tens and b the units of the number. From this proposition of the theory of numbers, that "every prime number, which will divide the product of two numbers, will necessarily divide one of these numbers," it is shewn to result, that "entire numbers, except such, as are perfect squares, admit of no assignable root, either among whole numbers or fractions."* Hence, the extraction of the square root, applied to numbers not perfect squares, makes us acquainted with a new kind of numbers, which, having no common measure with unity, or no relation to it that can be expressed by whole numbers or fractions, are termed *incommensurable* or *irrational*. A method is here given of approximating the square root of numbers not perfect squares, and also, the square root of fractions the terms of which are not both perfect squares.

Proceeding to the solution of equations of the second degree, he shews the reason why the double sign $\pm$ is considered as affecting the square root of every quantity, and explains what is to be understood when we say, that the square root of a negative quantity is imaginary. His general formula for resolving complete equations of this degree, is, $x^2 + px = q$, in which p and q denote known quantities, either positive or negative. After treating of the properties of negative solutions, and examining in what cases problems of the second degree become absurd, he gives an in-

* The reasoning here given, expressed in a summary way is this: entire numbers not perfect squares, it is obvious, can have no entire root; therefore, if they have a root, it must be among irreducible fractions; but irreducible fractions when squared, form still irreducible fractions which cannot become entire numbers.

genious and elegant demonstration of the doctrine, that there are two solutions to every equation of the second degree. This demonstration, also, contains the germ of the general theory of equations of any degree.

The binomial theorem, is rigorously demonstrated, and its extensive applications well pointed out. This was especially necessary with respect to a formula, that serves as a foundation for so great a number of important investigations. In the "elements," the demonstration is limited to the case of the theorem, in which the exponent of the binomial is a positive whole number; but in the "Supplement," it is extended to the cases, in which the exponent is fractional or negative. In his demonstration, instead of concluding the general expression of the theorem from the observation of some particular powers of a binomial, a method of proceeding which is defective because of the limited number of powers we are able to observe, he investigates the law which connects a preceding power with that which succeeds it, and this law thus connecting a series of powers of unlimited extent, makes all the remote results depend upon the first, which may be immediately and strictly verified. It is in this way that he has obtained the general expression of the terms of this celebrated formula of Sir I. Newton.

After employing the binomial formula to explain the extraction of the cube and other roots both of numbers and of literal quantities, he treats of "equations with two terms," and gives a specimen of analytical refinement not often to be found in elementary treatises. On "Radical Expressions," there is nothing very noticeable, except his remarks on some peculiar cases which occur in the calculus of these quantities, in which two or three dark points are illustrated from the theory of equations with two terms.

The necessary limits within which we are confined, will not permit us to enter into a particular examination of the "general Theory of Equations," and of "Equations exceeding the first degree." If justice were done to the subject, the discussion must necessarily be long, and might perhaps be tedious and uninteresting. We know not how a better selection of elementary methods for obtaining universal resolutions of equations, could have been made. The style, also, in which they are presented, corresponds with

the present state of mathematical science. They are taken principally from the writings of Newton, Clairaut, Euler and Lagrange. On the "resolution of Numerical Equations" by approximation, Sir I. Newton's "method by successive substitutions" is given with the improvements of Lagrange, by which it is simplified, and the degree of approximation at each step made known. Several other principles are introduced from Lagrange's "résolutions des Equations Numériques," which in some measure prepare the student to engage in the study of that very complete and profound treatise.

After equations, the leading principles in the theory of proportion and equidifference, are demonstrated with an ease and conciseness, which must surprise those who are acquainted only with the tedious method of Euclid and other ancient mathematicians. As proportion and equidifference may be expressed by equations with perfect convenience, we think it would be well to supercede our present parade of proportions by substituting the corresponding equations. Such a form of expression would be more simple as well as precise, and would at the same time, give greater uniformity to our methods. Progression both by differences and by quotients, is made to depend immediately upon the preceding principles, and general formulas are investigated to determine any particular term, the sum of any number of terms, &c. in each of them. Some elementary principles of the general theory of series, are likewise derived from the doctrine of progressions.

In his exposition of logarithms, M. Lacroix has adopted the view of them presented first by Euler in his "Introduction à l'analyse de l'infini," and of which the elementary part is developed with great care in the first volume of his algebra. In this view, all numbers are considered as produced by a constant number raised to a variable power; and logarithms are the exponents of the powers to which a constant number must be raised, in order that all possible numbers may be successively deduced from it. The celebrated Lagrange contemplates logarithms as derived from the same origin. To the objection, that these views are not sufficiently elementary, Euler long since answered, by treating the subject without any other preparatory knowledge than the arithmetic of powers. The treatise is con-

cluded by formulas for calculating the interest of money and annuities. These formulas are derived from progressions and logarithms, and form a useful application of algebra to the practical pursuits of life.

Our opinion of M. Lacroix's work, will be sufficiently collected from the preceding observations. The translation is performed with ability and fidelity. A few particulars, however, concerning both the original and translation merit notice. The demonstration of the binomial formula, we think, ought to be more elementary, as an understanding of it is at present too difficult for many such students, as are to be found in the American colleges. At least, the theory of permutations and combinations on which it is founded, ought to be more fully developed. In art. 42, there is an error both in the original and translation. "Recollecting," it is said, that a product has the same sign as the multiplicand when the multiplier has the sign $+$, and that it has in the contrary case the sign $-$, &c." It has: what has? the construction says the product has. But that appears otherwise, since $-$ by $-$ produces $+$. And the construction allows neither multiplicand nor multiplier to be the legitimate antecedent of *it*. But we conclude for the sake of truth, that the latter ought to be understood by the pronoun *it*; and that the reading ought to be thus; recollecting that when a product has the same sign as the multiplicand, the multiplier has the sign $+$; and that in the contrary case, it has the sign $-$ &c.* In page 114 the author appears to us to render a very plain thing, almost obscure. The letter x , in this case, is taken independently of either of the signs $+$ or $-$; being used independently of any relations expressed by those signs. It is an independent symbol of the value of the unknown quantity sought, whether this quantity is affected with the sign $+$ or $-$. There are instances of incorrect translation at pp. 18, 23, 54.....At p. 37 near the top, the last clause, "and retaining the accents, which belonged to the coefficients;" does not express the meaning of the original. Several valuable explanatory notes are added by the translator. In that given at p. 95, doubtless by inadvertence, the parentheses which ought to indicate the multiplications between the factors, are omitted. There is not a uniformi-

* The above remark was suggested by a valuable scientific friend.

ty in translating several technical words ; compare pp. 24, 38, 58, 62, 67, contents p. 7. The list of errata given at the end, might be considerably extended. There are several references that appear useless, pp. 68, 107. The translation is very free from French idioms. The worst we have noticed is at p. 7. Complaints have been made of the length of the problem commencing at p. 69. But when the importance and extensive application of the doctrine of the changes of the signs corresponding to the different directions of the couriers, and the difficult points illustrated in the course of the solution, are considered, the student can hardly conclude that he has been unprofitably occupied. A want of examples for practical exercise, has been objected to the work. On this point, M. Lacroix follows the course of the French and other continental mathematicians, which is, to give an extensive investigation of principles, and supply all necessary remarks ; and to depend principally on the instructor to see that the student is thoroughly versed in the practical application of them.

METAPHYSICS.



ART. XIV.—ON INFINITES.

By ISAAC ORR, one of the Instructors in the Asylum for the Deaf and Dumb at Hartford.

TO PROFESSOR SILLIMAN.

Dear Sir,

ON account of the diversity of opinion on the subject of infinites, it is certainly highly desirable, that some person competent to the undertaking should treat of them fully and systematically, as far as the human mind is capable of investigating them. The analogy existing between the various kinds of infinity would aid very much in their illustration. By the succeeding remarks, however, more humble in their aim, and yet perhaps bolder than the result will justify, it is intended merely to point out some, at least apparently, erroneous opinions that are prevalent, part of which

are frequent, part common, and part perhaps universal. It is not intended to say absolutely, that they are wholly, or even partially erroneous; but to place the arguments that bear against them in such a light, as to give them, if possible, their full efficiency. The opinions alluded to are the following.

We cannot comprehend infinity: our ideas about it are merely negative: we can tell what it is not, but we cannot tell what it is. Mathematical infinites and infinitesimals, although extremely great or extremely small, are still in all cases measurable by a finite mind. Numerical infinity is impossible; for any collection of units, however great, is with intuitive certainty numerable. The universe must be finite in extent, because its parts are finite, and finite parts cannot constitute infinity. The work of creation cannot have been eternal for the same reason, that it would imply an infinite series of units, or of finite parts, which is impossible. Matter and finite spirits cannot have been eternal, either in a combined or elementary state, because their eternity necessarily implies their independent existence, and precludes the need of a Deity. All systems, therefore, that assert or admit the eternity of matter, are atheistical.

When it is said that we cannot comprehend infinity, it seems difficult to tell what is meant by the assertion. If it is meant that we cannot encompass it in thought, or number its parts, there can be no doubt in the case; for from the nature of infinity and of the human mind, this is of course impossible. And if it is meant that we cannot know all the truth respecting it, this may be readily granted, for it is the case with regard to almost every subject of investigation with which we are acquainted. That we can know something about it is seldom disputed; and with infinity, as with other subjects, we may go patiently to work, and examine it as far as the utmost limit to which our minds can penetrate.

Mr. Locke says, "We have no idea of infinite space;" and afterwards, "We have no *positive* idea of infinite space, duration or number." It appears that he attempted to prove the less, because he was apprehensive that the arguments which he had adduced respecting the greater would not be satisfactory to all. Mr. Locke built well on his own foundation, or rather the foundation which had stood for ages

before him. It is true, that we can have no idea of infinite space, if it is necessary that such an idea should be a sensible species, a phantasm, or even an intelligible species floating in the mind. But this doctrine, notwithstanding the vast authority by which it was sustained, is now almost entirely exploded: and after the main structure has been overthrown, it seems as if no one need hesitate to cast the fragments out of the way. According to the new and probably correct doctrine of ideas, we may be said to have an idea or ideas of any thing respecting which we can with certainty make either a positive or negative assertion. Our ideas of a complex subject may be incomplete, and even some of them erroneous: but by this circumstance the title of those that are correct to the name of ideas, cannot be forfeited. If we are listening to the description of a mineral, and are told that it is not like a diamond, we then have a negative idea respecting it: we know what it is not, yet from this information we do not know what it is. And if we are told that it is not like an emerald, this gives us only an additional negative idea; and so all the account that can be given respecting it, which merely enables us to know that it differs from other things, while it gives us no insight into its real qualities, is entirely negative. But it is worthy of remark, that the very name *mineral*, under which the account is given, conveys to us a positive idea. The assertions that it is not like a diamond or an emerald, are not in their widest sense strictly true. We perceive that like the diamond and the emerald it is solid and visible; and these perceptions are positive. Again, if we are told that it is not opaque, the expression, though given in the negative form, conveys to us a positive idea: we see at once that it is translucent. Translucency or opacity being the property of all minerals whatever, the terms, as well as the meanings which they properly convey, like the terms of an algebraic equation, may be either negative or positive, that circumstance being entirely dependent on the situation which they hold in the sentence. It is needless to add another of the numerous instances that occur of a similar description. In all cases where the negative ideas are restricted to a certain number, and all but one are given; that is, if we know that a thing, circumstance, or property, is comparable or identical with one of a number of other things, circumstances or

properties, and are told that it is unlike all but one of them, a positive idea of the subject is then inevitable. It ought to be kept in mind that positive and negative are entirely distinguishable from complete and incomplete, competent and defective. Though in many cases one will involve the other, yet the line of distinction cannot be mistaken. If the rule for positive and negative ideas, deduced from the above remarks, is not the right one, it is obvious that no fixed and general rule can be given; but the subject is left entirely to the caprice or convenience of the individual who discusses it. If it is the right one, then we have a positive idea or ideas of a subject, when we know to the least extent any of its intrinsic properties; and merely negative ideas, when we know only that it is diverse from several things specified, and yet, as far as our minds are concerned, subject to all the boundless variety of real and possible forms and conditions which are not specified. It would seem, then, that our idea of infinite space is as positive as it well can be; for we see with intuitive certainty that it is wholly unlike all other real existences that are possible. Mr. Locke takes some pains to prove, that infinite space is a real existence. But a writer in a modern, and justly celebrated work, asserts that God alone is infinite, and that space is a mere nonentity; not having in itself even a finite existence, but possessing the potentiality of admitting existence. He asserts at the same time, that mind with its affections has no relation to space. To assert that the inevitable perception of extent without limitation, which is present in almost every mind, is solely and entirely the perception of an attribute of the Deity, and then virtually to declare that mind is incapable of such an attribute, evinces a versatility and variety in the application of terms, which, however much it may amuse the imagination, and exercise the intellect, communicates a needless obscurity to the style and to the argument. The same writer admits that wherever there is matter there is space; that God can make his works infinite; and yet without proving or even supposing that he has not made them so, he virtually declares, that if these works are not infinite, infinite space is a mere nonentity, existing only in conception. Notwithstanding the seeming incongruity of this language when taken in its usual acceptation, it appears probable enough, that he had the same idea of

what has been heretofore termed infinite space, as existed in the mind of Mr. Locke; and indeed, as it seems impossible should not exist in every mind that has turned itself to the subject, and is capable of taking a single step in the course of an argument. If there is any use in a circumlocution, there can be no objections to calling it, the infinite potentiality of admitting existence; or it may be called nonentity, though a mere child in philosophy would be sure that it is infinite nonentity. Besides, it seems too much like dooming the term *nonentity* to penance for its past deficiency, and decreeing, that whereas it has heretofore conveyed from mind to mind the idea of a nothing of no extent, it shall hereafter convey the idea of an infinite nothing.

Mr. Locke remarks, that by repeated additions of the idea of finite space we come at the idea of infinity of space, but not at the idea of space infinite. This indeed looks a little like supposing that infinite space has a substratum.

Dormitat aliquando etiam bonus Homerus. The human mind usually in its first steps towards the idea of infinite space, annexes finite to finite space several times successively; but it does not appear certain that this is always the case. However far the idea of specific finite space is carried, the mere perception that there is space beyond it, by no means implies the perception of infinite space, for the limits of finite space are in all cases also beyond it. This process appears to be merely opening the eyes of the intellect. The ultimate process is to set up an imaginary limit without any reference at all to the position or intervening distance, and to substitute it for all supposable limits whatever; and the mind then perceives with instant intuition that all such limits are wholly an absurdity.

The error with regard to mathematical infinity and infinitesimals, exists principally in those minds which are not accustomed to look beyond the steps of a demonstration, as they are laid down before them. President Day in his excellent system of algebra has given the following definition of infinites and of infinitesimals. "Infinite in the highest and most proper sense, is that which is so great that nothing can be added, or supposed to be added. A mathematical quantity is said to be infinite, when it is supposed to be increased beyond any determinate limits. When a quantity is diminished till it becomes less than any determinate

quantity, it is called an infinitesimal." These definitions are perfectly correct, taking in the two last "any determinate limit," and "any determinate quantities," for all determinate limits, and all determinate quantities whatever. The idea of mathematical infinity can be clearly obtained only from space and duration. In abstract number if we add millions to millions for ever so long a period, we see with certainty that the numbers thus obtained are in all cases finite. And if we suppose an abstract number infinite in the highest sense, that is, so great that nothing can be added to it, or supposed to be added, the mind sees at once that the supposition is an absurdity. It even appears while we deal only with abstract numbers, as if there could not be such a number really infinite, even in a mathematical sense; that is, so great, that though it is capable of increase, it is notwithstanding incalculable by every finite mind. But if we suppose a line infinite in one direction, and terminating in the other at a given point, this line may properly be said to be mathematically infinite: for though it is evidently capable of increase, yet it is measureable by no finite mind. In the same sense past duration has been infinite: it is capable of increase, but the repetition of no finite duration can measure it. But in this sense future duration never will and never can be infinite. The infinity which is usually applied to it is the infinity of a mere abstraction of the mind. We see, it is true, that future duration will never terminate, but we see with equal certainty that it will never arrive at infinity. We will at present take it for granted that the infinite line supposed above, and infinite past duration, may be divided into finite parts. Then however far the idea of the finite part which we call unity is extended, we shall have in each case a number mathematically infinite. It is usually said, that we obtain the idea of an infinitesimal by dividing a given space, or numerical unit into a certain number of parts, then into a greater number, and so on, increasing at each step, till the mind is wearied, and then because we see that the number may be still increased, and the quantity of each part diminished, we conclude there may be a part so small that no finite mind can measure it. It is obvious that these steps are exactly analogous to those which are first taken in quest of the idea of infinite space. How the mind draws the conclusion that the

spaces or expressions may be infinitely small when it knows with certainty that their becoming so by this process is wholly impossible, may seem mysterious. But the mystery lies in another step of which perhaps we are not always conscious. We suppose a space between two limits, and substitute it for all measureable spaces whatever. We know that the substitution is perfectly correct. Then the space not being in any case absolutely nothing, and the limits being of no extent, we see with certainty that another separating limit of no extent can be crowded in between them. It would seem as if no judicious mind could feel a conviction of the possibility of a quantity infinitely small merely from the first similar steps of the process : and even with the last additional one the subject remains considerably obscure : for notwithstanding the conditions of the problem, the mind still seizes on the ultimate portions, as measurable by finite quantities. But suppose a fractional expression, the numerator of which is one, and the denominator a series of figures infinitely extended. That the supposition of such a series is admissible, we have already taken for granted. The proof will come hereafter. We should then obviously have the expression for an extent so small that no finite mind could measure it. Taking this supposed extent as in the case above, and placing it between two limits, we see with certainty, that it is not absolutely nothing : and the supposed limits having no extent, we see with the same certainty, that an intervening limit of no extent can be pushed in between them. Here then, after the space is infinitely small, we see that it may still be divided and diminished.

On the subject of an infinite series of units, I am happy to adduce the opinion of the late Professor Fisher, in his own language. "If you say it is metaphysically impossible that the earth should have performed infinite revolutions about the sun, you maintain that there was a certain revolution and a certain point in the orbit, suppose A, at which it must have begun to move. In other words, it is seen by the mind to be impossible, that the earth should have described an arc of a foot before the point A. But the mind does not in fact perceive any such impossibility : on the other hand, it appears just as easy, that the foot which precedes this point should have been described, as

the foot which follows it. However far we push back an idea of the earth's revolving, nothing obliges us to stop, and to say, at this point it began to move." It is obvious that each of the revolutions supposed in the above argument, would be a unit. It proves, therefore, the possibility of an infinite series of units. It of course proves also the possibility of an infinite universe, and of an eternal work of creation. But it is by no means the only argument. It is not intended at present to show that the universe is actually infinite or that the work of creation has been eternal; but merely that either supposition involves no absurdity. It is admitted by all that God is every where present, and it will not be denied that wherever he is present, he can create; for to ad-duce and believe such a denial would at once destroy the idea of his own omnipotence. The conviction then, must be irresistible, that God has the power to make the universe infinite. A concession to this effect is all that is requisite. Suppose that he had made it infinite, and instead of placing the stars in their present order, had arranged them regularly in parallel lines, having a given distance between them, say twenty billions of miles. Take the stars in one of these lines, and the line being infinite, we see with certainty that the number of stars in that line would also be infinite; not in the highest sense, for of such infinity, number is not capable; but so great as to be incalculable by any finite mind. Take all the lines of stars that lie in a single infinite plane, and it is obvious that there will be an infinite number of lines, in each of which an infinite number of stars or units is included. Again, take all the infinite parallel planes, and there are an infinite number of planes or units, each of which contains an infinite number of lines or units, and each of these lines contains also an infinite number of units. Here then, we have the cube of an infinite number. If these expressions appear incoherent to any one, let him for a moment divest his mind entirely of language, and the ideas will be unequivocal, and light as day. Again, it is granted by all, that God is eternal; and also that his power of action has been eternal. It will also certainly be granted, that this power might have been exerted at every period of its existence, or else it was not a power. If it might have been exerted eternally, then eternal creation is no absurdity.

Mr. Fisher observes, when remarking on the possibility of an eternal creation as an effect of Divine power, "If there be any seeming inconsistency in the language *eternal effect*, we may call it an eternal existence dependent on another eternal existence, in such manner, that if the latter had never existed, the former never would. I have sometimes illustrated it to myself in this manner. Suppose a straight rod to begin at the earth and to stretch towards the north. Let it be supposed immovable, but that all other matter gravitates in lines at right angles to it, and tends to fall away from it. A chain may be hung parallel to this rod, by means of wires placed at moderate distances. It is self-evident, that the chain may be supported to as great a distance as the rod stretches; and therefore if the rod stretches to infinity, it will support a chain of infinite length. The analogy of extension to duration admits this conclusion to be extended with intuitive clearness to the latter." To some it may perhaps appear necessary, that if the agent and the work are coeternal, the volition and the effect must be in all cases contemporaneous. But if the agent has been eternal, and if he has been eternally at work, and if we admit the necessity in every case of a time intervening between the volition and the effect, we see with certainty that the admission involves no difficulty except with regard to the original act. But the supposed original act of a being eternally at work is an absurdity. To those however who still consider it indispensable that the volition and the effect should be coincident with regard to duration, it may be answered, that so they might be. If it be said that the Deity necessarily requires any time in which to perform one of his operations, that time may be expressed by a finite number, or infinitesimal. But to say that he cannot perform an operation in a less time than a given one, is virtually to say that his power is limited. It will doubtless be objected, that if the work of creation has been eternal, then some one portion of the universe must alone have been eternal, and therefore could not have been created. This portion the mind perceives must have been the original one. But the original unit of an eternal series is an absurdity. Besides if such an argument is admissible, it will equally well disprove infinite duration and infinite space. For it is obvious that in past duration, any point whatever may be assumed by a finite mind; but it sees

with certainty that the period between that point and the present is finite. Therefore infinite duration is impossible. From this fallacy, however, it leaps with alacrity, for it perceives with the quickness of instinct, that of such finite quantities however great, eternal duration comprehends an infinity. So of infinite space any two points may be assumed, and therefore space cannot be boundless, because the space between those points is finite. But of such finites, infinite space obviously comprehends an infinity. In order that the line between two points should be infinite, it is necessary that they should be extreme points. But extreme points in infinite space, is a contradiction in terms, and an absurdity. To many minds that discuss infinites, it seems a most mysterious circumstance, that they fall into so many inevitable fallacies, and find arguments of apparently irresistible force set point blank against each other. But it is well worthy of remark, that such fallacies are never incurred, except when we attempt to measure infinites by a finite number of finite quantities; a mode of proceeding which leaves less ground for wonder at its results, than at the genius that prompted it.

The opinion that the eternity of matter and of finite spirits, necessarily implies an independent existence, is founded on the habit of reasoning from analogy. We have been accustomed to consider the Deity alone possessed of eternal existence, and the supposition that he only has existed eternally, unavoidably implies that he is independent. Hence when we attribute eternity to any other existence, we are apt to conclude, that whereas independence is obviously a necessary concomitant of eternity in the Supreme Being, it must be so of course in the case of all other eternal existences. Eternal creation as supposed above is strictly eternal; and yet is as perfectly dependent on the Deity as if it were not supposed eternal. Should it be said, that if matter and finite spirits are dependent on the Deity for existence, they cannot have been eternal; then there was a certain point in duration before which the Deity could not uphold them in existence; and between the present time and that point the duration is indispensably finite. Therefore during an eternity God had not the power to uphold the world. It is needless to say that this is an absurdity. If we assert that it was necessary for him to create them sometime before their capability of being upheld in existence, then, as stated above, God cannot per-

form his works without a given time to do it. The preceding arguments tend only to show that the universe may be finite or infinite, and that matter and finite spirits, or the work of creation may have been temporal or eternal. The knowledge of what has occurred, and what exists in fact, if it should be ever obtained, depends entirely on a different train of arguments.

With much respect,
your obedient servant,

ISAAC ORR.

Hartford, July 31, 1822.

CHEMISTRY, PHYSICS, &c.

ART. XV.—*Analysis of the Maculurite, or Fluo-Silicate of Magnesia, a new mineral species, from New-Jersey; by HENRY SEYBERT, of Philadelphia.*

Read before the American Philosophical Society, on the 17th of May, 1822.

THE colour of this mineral is generally wine yellow, sometimes reddish brown, and occasionally presents a greenish hue; reduced to powder, it is of a pale yellow colour. Its lustre is most frequently vitreous, but some specimens approach nearer to that of wax. In mass it is, for the most part, opaque; small fragments are generally transparent. Its form is irregularly lenticular or spheroidal, but it never occurs regularly crystallized; it exhibits a crystalline structure, and presents two cleavages in opposite directions. I have not been able to obtain the primitive form by mechanical division. The fracture in one direction, is distinctly lamellar, in the opposite, it is less regular. Fragments indeterminate. It scratches fluor spar and glass, and gives sparks abundantly with steel. It occurs imbedded in carbonate of lime, accompanied by carbonate of iron, and occasionally by minute portions of mica. The size of the spheroids varies from that of a pin's head, to several inches in diameter, and they often embrace carbonate of lime and carbonate of iron as nuclei. Its specific gravity varies from 3.157 to 3.225. Before the blowpipe it is infusible

per se; with borax it yields a transparent colourless and vitreous globule.

Analysis, (No. 1.)

A. Three grammes of the pure mineral, in the state of an impalpable powder, were exposed to a red heat, in a platina crucible; after the calcination, the colour of the powder had become a shade darker, and it weighed 2.97 grammes, therefore the moisture, dissipated by calcination, amounts to 0.03 grammes on three grammes, or one per one hundred.

B. The calcined mineral (A) was boiled with nitro muriatic acid, the acid readily acted on it, and converted it into a jelly; the mixture was evaporated to a dry mass, which was treated with water acidulated with muriatic acid, and again moderately evaporated; more water was then added and the solution was filtered, to separate the silica, which, afteredulcoration and calcination, weighed 0.91 grammes, on 3 grammes, equivalent to 30.333 per 100. At the close of the calcination, I observed that the upper surface of the crucible was coated with a very minute portion of a white sublimate, but as the matter was very inconsiderable in quantity, I supposed it to be a portion of the silica adhering to the crucible, and therefore deemed it unnecessary to examine it.

C. After the separation of the silica, (B) the liquor was neutralized with caustic potash; it was then treated with the hydro-sulphate of potash, which occasioned a black precipitate; this precipitate, after being well washed, was calcined in a porcelain vessel, to expel the greater part of the sulphur; it was then treated with a little nitric acid and exposed to a strong red heat, in a platina crucible; after this calcination it weighed 0.05 grammes on 3 grammes, or 1.666 per 100; this product, on examination with caustic potash, was found to contain neither manganese nor alumina, and thus proved to be peroxide of iron.

D. The liquor (C) when tested with oxalate of potash, gave no trace of lime.

E. The liquor (C) treated with an excess of caustic potash, gave an abundant flocculent precipitate, which, on exposure to a strong heat, yielded 1.70 grammes of magnesia on 3 grammes, or 56.666 per 100.

From the above analysis we have the following result:—

<i>Per 100 Parts.</i>					
A. Water,	-	01.000	containing oxygen		
B. Silica,	-	30.333	- - -	15.257	
C. Peroxide of Iron,	01.666	-	- - -	00.510	
E. Magnesia,	56.666	-	- - -	21.935	
89.665					
100.000					
10.335 Loss.					

Analysis, (No. 2.)

The great deficiency in the above results, in regard to the 100 parts of mineral employed, rendered it highly probable that an alkali was an essential constituent of this substance. The analysis was then repeated in the following manner:

A. Three grammes of the mineral were finely pulverized and exposed to a red heat; the colour of the powder was not materially altered; the weight, after calcination, was 2.98 grammes, therefore the moisture volatilized, by calcination, was 0.02 grammes on 3 grammes, or 0.666 per 100.

B. The residue of the calcination, (A) was treated as in the preceding analysis, the silica, separated by filtration, after exposure to a red heat, weighed 0.93 grammes on 3 grammes, or 31.0 per 100. The interior of the crucible again presented appearances similar to those stated in the first analysis.

C. The per oxide of iron obtained from the liquor (B,) by the hydro-sulphat of ammonia, weighed 0.09 grammes or 3 grammes, or 3.0 per 100.

D. The liquor (C,) was treated with an excess of lime water, the precipitate produced was very abundant; after being perfectlyedulcorated and strongly calcined, it gave 1.68 grammes of magnesia on 3 grammes, or 56.00 per 100.

E. The liquor (D,) which was very voluminous, was concentrated by evaporation, and the lime was precipitated by oxalate of ammonia; the liquor was then filtered, and evap-

orated to a dry saline mass, and the residue was exposed to a red heat, to expel the ammoniacal salts; the fixed salt weighed 0.12 grammes; when treated with water it dissolved, leaving 0.02 grammes of insoluble matter, the filtered solution, on being slowly evaporated, furnished very minute irregular cubes, which, when dried and exposed to the atmosphere, did not deliquesce; they were dissolved in water, and the concentrated solution when treated with the muriate of platina, gave a yellow precipitate of muriate of potash and platina, which was very abundant in proportion to the quantity of salt employed; the alcali thus proved to be potash, and the 0.10 grammes muriate of potash are equivalent to 0.06326 grammes of potash on three grammes, or 2.108 per 100.

The products of this analysis are as follows:—

	Per 100 Parts.
A. Water,	00.666
B. Silica,	31.000
C. Per oxide of Iron,	03.000
D. Magnesia,	56.000
E. Potash,	02.108
	92.774
	100.000
	7.226 Loss.

From the preceding result I was satisfied, that this mineral must contain some other constituent than those which I had detected in it, and on comparing the oxygen of the silica with that of the magnesia, it appeared very probable, that it might be an acid. I searched for boric acid without success. To discover *Fluoric acid*, I proceeded in the following manner, 1st, a portion of the pulverized mineral was heated with an excess of sulphuric acid, and a piece of glass was exposed to the fumes, which were disengaged from the mixture, but it exhibited no signs of corrosion; from this experiment, I could not conclude the absence of fluoric acid, for the silica contained in the mineral would probably have been sufficient to saturate it, and thereby prevent its action on the glass. 2. Three grammes of the pulverized mineral were fused, during thirty minutes, in a

silver crucible with nine grammes of caustic potash ; when the matter had cooled, it was treated with water, and the solution was filtered, the filtered liquor was supersaturated with muriatic acid, the solution was treated with an excess of ammonia, this produced a gelatinous precipitate, which was separated by filtration, the filtered liquor was again treated with a slight excess of muriatic acid, and boiled to expel the carbonic acid, it was then exactly neutralized with ammonia, and treated with lime water, no precipitate was formed, and it was treated with muriate of lime with the same result ; these experiments induced me to believe, that the mineral in question contained *no* fluoric acid, nevertheless, to reduce this fact to greater certitude, I followed precisely the method employed by Professor Klaproth, in his analysis of the Pycnite, viz. three grammes of the substance, reduced to a fine powder, were calcined in a silver crucible, with caustic potash, the silica was separated in the usual way, the liquor was treated with an excess of sub-carbonate of soda, to precipitate the Magnesia ; after filtration the carbonic acid was expelled, from the liquor, by an excess of muriatic acid and subsequent ebullition, it was then exactly neutralized with ammonia, and treated with a solution of pure lime and muriate of lime, without any precipitate having been produced by these reagents.

My attempts to discover Fluoric acid having thus proved fruitless, I determined to direct my attention to the appearances which occurred during the calcination of the silica in the two preceding analyses, the sublimate was very minute in quantity, I prepared some of it from silica obtained, from the mineral, as in the preceding analyses. The silica was dried, at a moderate temperature, and then exposed to a red heat, in a small glass retort ; before the glass was reddened, there passed over a small quantity of water, and a white sublimate appeared on the dome of the retort ; as the heat increased, this sublimate descended into the neck, and lastly, partially, into a receiver adapted to condense it. After the calcination, the retort was removed from the fire, the receiver contained only a very small portion of the sublimate, and a vapour possessing a very pungent odour, which reddened litmus with great energy : the sublimate incrusting the neck of the retort was colourless, and very acid to the taste, in water it dissolved partially, leaving a flaky residue, the liquor became

strongly acid; when treated with concentrated sulphuric acid it effervesced rapidly, disengaging a pungent gas, giving rise to dense white vapours in the surrounding atmosphere, its solution in the acid was but partial; this sublimate thus presented properties analogous to the Fluato of silica. To investigate this matter more satisfactorily, I made the following comparative experiments, viz. a portion of the powdered mineral was heated in a glass retort with an excess of sulphuric acid. A mixture of three parts of Fluor spar and one part of silica was then treated in the same manner, the results obtained were precisely similar, a white pungent vapour was disengaged, which condensed, on coming in contact with water, in the form of a white film, and the neck of the retort was incrustated with a white sublimate, which effervesced with sulphuric acid, yielding a gaz which presented the properties of Fluo-silicic acid. These experiments clearly demonstrated, that Fluoric acid was a constituent of the mineral under examination, and I was induced to repeat the experiments above stated according to Professor Klaproth's method, but they were not attended with better success; on examining the silica, obtained in this manner, I observed that it possessed certain properties, which proved that it had retained Fluoric acid; when thrown into water it decrepitated and rendered the liquor acid; with sulphuric acid it effervesced violently, yielding Fluo-silicic acid: the silica, therefore, was intermixed with Fluato of potash and silica, a compound described by Gay Lussac* and Thenard. They state, that potash combines with silica and Fluoric acid, forming a compound which requires six or seven hundred times its weight of water to dissolve it. I also ascertained, that the magnesia, although precipitated by an excess of caustic or carbonated alkali, likewise retained a portion of the Fluoric acid; the cause of my not having obtained any Fluato of Lime from the solutions above mentioned, was thus rendered apparent. I thought to obviate this difficulty in employing Soda instead of Potash, in this manner I succeeded in obtaining some Fluato of Lime, but I ascertained, that the Silica and magnesia still retained a portion of the acid and at length after various experiments, I resorted to the method employed, so successfully, by Professor Berzelius

* *Recherches Physico-Chimiques* vol. ii. p. 19.

in his analysis of the Pyrophysalite, Pycnite and other Topazes.

Analysis.

A. Three grammes of the pure mineral, finely pulverized and subjected to the action of a red heat, underwent no material alteration, except a diminution of 0.03 gr. on 3 grammes, hence we have 1.0 per. 100 of water.

B. The calcined mineral (A), was exposed to a red heat, during one hour in a platina crucible, with 18 grammes of crystallized sub-carbonate of soda, the mixture did not fuse, when cold its colour was yellowish brown, it was treated with water and the solution was filtered, the filtered liquor was treated with an excess of acetic acid, when treated with carbonate of ammonia it gave no precipitate; it therefore contained no silica: it was again supersaturated with acetic acid and boiled to expel the carbonic acid, the excess of acetic acid was then neutralized with ammonia, and the liquor was treated with muriate of Lime, which occasioned a white, flaky precipitate, possessing the properties of fluuate of lime; when calcined, it weighed 0.44 grammes: this result was verified by a second experiment, in which I obtained 0.43 grammes of fluuate of lime, and on calcining the mineral a second time, with sub-carbonate of soda, I ascertained that the fluoric acid had been completely separated, the 0.44 grammes of fluuate of lime are equivalent to 0.12258 grammes of fluoric acid on 3 grammes, or 4.086 per 100.

C. The residue, on the filter (B), was treated with muriatic acid, which converted it into a jelly; it was evaporated to dryness, then treated with water acidulated with muriatic acid, and again moderately evaporated, more water was added and the solution was filtered, the silica, remaining on the filter, after edulcoration and calcination, weighed 0.98 grammes on 3 grammes, or 32.666 per 100. A second experiment yielded precisely the same quantity of silica.

D. The iron was separated from the liquor (C), as in the 1st Analysis; the per-oxide thus obtained, weighed 0.07 grammes on 3 gr. or 2.333 per 100.

E. The magnesia was precipitated from the liquor (D), with an excess of caustic potash, after a strong calcination it weighed 1.62 grammes on 3 grammes, or 54.00 per 100.

The constituents of this mineral are therefore,

Per 100 Parts.

A. Water	01.000	Containing Oxygen.	
B. Fluoric Acid	04.086		02.971
C. Silica	32.666		16.430
D. Per Oxide of iron	02.333		00.715
E. Magnesia	54.000		20.903
Analysis(No.2)F.Potash	02.108		00.357
			96.193
			100.000
			003.807 Loss.

In regarding this analysis according to the theory of chemical proportions, this mineral evidently consists of an atom of sub-fluate of Magnesia, combined with three atoms of silicate of Magnesia, the fluuate of Potash and silicate of Iron being unessential ingredients, therefore its mineralogical formula will be $M^2Fl + 3MS$.

The subject of the preceding examination, I have been told, was discovered several years ago, by the late Dr. Bruce, near Sparta, in Sussex Co. New-Jersey. When our mineralogists became first acquainted with this substance, it was supposed to be *Sphene*: subsequent investigations led to its being ranked with the *Condroidite*, a mineral discovered in Sweden, and analysed by M. d'Ohsson. The experiments of this gentleman were repeated and verified by Professor Berzelius the results were as follows: viz.—per 100, Silica 38, Magnesia 54, Oxide of Iron 5.1, Alumina 1.5, Potash 0.86, Manganese a trace, loss 0.54.* From the preceding summary, it is evident that the two substances are essentially different in their chemical composition, though they much resemble each other in their physical characters. Magnesia not having heretofore been found combined with

* Journal of the Royal Institution of G. B. 1822, No. 24.

fluo-silicic acid in a native state ; the subject of the preceding experiments, must therefore constitute a *new species* in our mineralogical system, and I propose to call it *Maclureite*, as a mark of my respect and esteem for Mr. Wm. Maclure, to whose efforts we are much indebted for a knowledge of the Mineralogy and Geology of the United States.

ART. XVI.—*Analysis* of the Pyroxene Sahlite, from the vicinity of New-Haven, Conn.* By GEORGE T. BOWEN, of Providence.

This mineral is found 2 or 3 miles west of New-Haven, imbedded in green serpentine marble. Its colour is grayish green ; the colour of its powder is light gray—its structure is crystalline—easily breaking into rhombic fragments ; no distinct crystals, have, however, been observed—its fracture in one direction is foliated, having a vitreous lustre ; the cross fracture is uneven and nearly dull—it is translucent at the edges—its hardness is nearly equal to that of augite—it is not magnetic—before the blowpipe it is fusible with difficulty into a dark coloured globule—its specific gravity varies from 3.127 to 3.294.

Analysis.

A. 50 grains of the mineral having been carefully freed from foreign substances, were reduced to an impalpable powder, and exposed during one hour to a high red heat in a platina crucible. The powder after calcination was a shade darker than before, and weighed 49.766 grains. The loss by calcination was therefore .234 grains, or .468 per 100.

B. After calcination the mineral was fused with three times its weight of caustic potash in a silver crucible and kept a red heat during one hour. The mass after fusion was of a grass green colour, which it imparted to the water used to detach it from the crucible. Muriatic acid was added in excess, and the fluid evaporated to dryness. It was then treated with water acidulated with muriatic acid, and the silex separated by the filter ; when washed and calcined, it weighed 26.562 grain or 53.124 grains per 100.

* Done in the Laboratory of Yale College.

C. The liquor (B) having been neutralized with ammonia, was treated with the hydrosulphate of ammonia. The black precipitate which was produced after being heated to expel the sulphur, and calcined with nitric acid, weighed 4.192 grains. The alumine separated in the usual manner by the action of caustic potash, weighed 531 grains or 1.062 per 100.

D. The metallic oxides, after the separation of the alumine, weighed 3.645 grains. They were treated with muriate of ammonia to which a small quantity of sugar had been added, in order to separate the manganese. The *peroxide* of iron remaining, was equal to 3.004 grains of *protoxide* in 50 grains, or to 6.008 grains per 100. The *protoxide* of manganese amounted to .598 grains per 100.

E. Oxalate of potash was then added to the liquor, (D.) The precipitate of oxalate of lime when calcined yielded 11.810 grains of lime, or 23.620 grains per 100.

F. The magnesia was precipitated from the solution, (E) by caustic potash at a boiling heat; when washed and calcined, it weighed 07.250 grains or 14.500 per 100.

The results of this analysis, give as the composition of this mineral per 100 parts:—

A. Water		00.468	containing oxygen.
B. Silica		53.124	 26.72
C. Alumine		01.062	
D. Protoxide of Iron		06.008	 01.36
D. Protoxide of Manganese		00.598	
E. Lime		23.620	 06.63
F. Magnesia		14.500	 05.81
		99.380	
		100.000	
		000.620	loss.

Some mineralogists have considered this substance as *Diallage*. The preceding experiments, however, sufficiently prove that it is distinct from that mineral. In its external characters, and also in its chemical composition, it corresponds almost exactly with the *Pyroxene Sahlite* of Sweden. It was discovered a number of years since by Pro-

fessor Silliman, at one of the marble quarries, near New-Haven, and his opinion was that this mineral coincided exactly with the Swedish Sahlite or Malacholite.

ART. XVII.—*Analysis* of a variety of Nephrite, from Smithfield, R. I.* By GEORGE T. BOWEN, of Providence.

This beautiful mineral occurs at Smithfield, imbedded in large nodules in white primitive limestone. Its color is bright apple green—sometimes tinged with blue; the colour of its powder is white—its hardness is equal to that of felspar—its fracture dull and splintery—it is highly translucent, and very difficult to break on account of its great tenacity—before the blowpipe it is infusible. Its specific gravity varies from 2.594 to 2.787.—Its powder when boiled with sulphuric or nitromuriatic acid, is entirely decomposed; the obtained solution yielding an abundant precipitate with Phosphate of soda and ammonia.

Analysis.

A. Fifty grains of the mineral in the powder were exposed, during thirty minutes, to a red heat in a platina crucible; the colour of the powder was not altered. The weight after calcination was 43.250 grains; the moisture dissipated amounted therefore to 6.750 grains in 50 grains, or 13.500 per 100. A piece of the mineral weighing 100 grains was then heated during thirty minutes, without having been reduced to powder. Its green colour disappeared; it lost its translucency, and became of a pure white; its hardness was also much increased as it now scratched glass with facility. The loss of weight amounted to 13.625 grains. The mean of three experiments gave as the loss by calcinations 13.417 grains per 100.

B. One hundred grains of the mineral in powder were fused with 300 grains of caustic potash, in a silver crucible, and kept at a red heat during one hour. The contents of the crucible, when removed from the fire, were of a light green colour.—Muriatic acid was added in excess, and the fluid evaporated to dryness.—The dry mass was then treated with water acidulated with muriatic acid; the silex sep-

* Done in the Laboratory of Yale College.

arated in this manner, when washed and calcined, weighed 44.688 grains.

C. The solution (B), was neutralized with ammonia and treated with the hydrosulphate of ammonia.—The precipitate when ignited and calcined with nitric acid weighed 2.313 grains. When fused with caustic potash, it imparted to it a tinge of green, giving indications of a trace of manganese. The oxide of iron remaining after the action of caustic potash, amounted to 1.747 grains. We have then by difference alumine equal to 0.562 grains.

D. The lime was precipitated from the liquor (C), by the addition of oxalate of potash; when calcined it weighed 4.250 grains.

E. To the remaining solution, (D), after the separation of the lime, caustic potash was added in excess, and the fluid boiled. The magnesia separated by this treatment, when washed and calcined, weighed 34.631 grains.

F. 250 grains of the mineral were introduced into a small porcelain retort which was connected with the mercurial apparatus, and kept at a red heat during one hour. A portion of water distilled over, but no carbonic acid was obtained.

The composition of this mineral is therefore,

Per 100 Parts.

A. Water	13.417	containing oxygen	11.17
B. Silica	44.688		22.47
C. Alumine	00.562		—
C. Oxide of Iron	01.747		—
D. Lime	04.250		01.09
E. Magnesia	34.631		13.40
G. Oxide of Manganese	a trace		—
	99.295		
	100.000		
	000.705	Loss.	

On comparing the results of the preceding experiments upon this substance, with the analyses of Nephrite which have been hitherto published, we find a considerable difference in chemical composition; the Smithfield mineral contains a much greater proportion of water, and only a very small quantity of alumine. It differs from Nephrite also in

its inferior hardness, and its infusibility before the blow pipe. It corresponds in other respects with the descriptions of that mineral given in the books, and possesses in a high degree that peculiar tenacity which is so characteristic of the different varieties of Jade.

ART. XVIII.—*Letter from ROBERT HARE, M. D. Professor of Chemistry in the University of Pennsylvania, on Alkanet as a substitute for Litmus or Turmeric, &c. also on preparing pure nitrate of silver and on Nitrate of Ammonia for Nitrous Oxide.*

HAVING infused some Alkanet roots in Alcohol, I was surprized at finding the infusion blue instead of red. Recollecting that the Alcohol employed had stood over Pearl-ash, I tried some of the roots in pure Alcohol, when a red tincture resulted which was rendered blue by a drop of any alkaline solution.

In our chemical compilations I never have met with any account of this habitude. No notice is taken of it under the article Alkanet in Ure's or Aikin's Dictionary. On the contrary the broad assertion is constantly repeated, that acids redden vegetable blues, while alkalies make them green. Yet, as litmus is not converted to a green, and alkanet is made blue by alkalies, it is evident that they not only fail in rendering some blue infusions green, but may render red infusions blue. From the process of manufacturing Litmus we may infer, that its colour is developed by an alkali.

Alkanet roots may be used in place of Litmus, producing the same phenomena in a reversed order. The Alkanet infusion must be made blue by an alkali and restored by an acid, instead of being as in the case of litmus, reddened by an acid and restored by an alkali. Thus as the one is indirectly a test for alkalies, so is the other for acids. In making the infusion of alkanet blue for this purpose, the smallest quantity of alkali should be used, which will accomplish the change, as in that case less acid will be requisite to restore the colour, and thus manifest its presence in any solution to be tested.

I have ascertained that the white crystals which form spontaneously, when silver coin is dissolved in nitric acid, diluted no more than is necessary for the solution to proceed actively, give no trace of copper when redissolved. May not this be a good preliminary step in refining that metal, or for obtaining the nitrat either for lunar caustic or as a test.

I have observed that the strong nitric acid procured from dry nitre, may be saturated with carbonate of ammonia in a retort, and nitrous oxide procured forthwith, by distillation. The salt produced is in the compact form. Instead of metallic air-holders, I make use of bags, such as are made by Pixii at Paris, (such as are called by him *Réservoir en Baudruche*) passing the gas through water by an apparatus, of which I will send you a drawing as soon as convenient. I find that bags of leather, soaked with boiled linseed oil, will answer to hold the oxide gas.

 This letter was written a twelve month ago. The facts have since been added in notes to the American edition—Ure's Nicholson's Dictionary.

ART. XIX.—On the Combustion of Hydrogen in water—being a new application of Hare's Blowpipe.

For the American Journal of Science.

MR. EDITOR,

I HAVE discovered, within three or four months back, that if the flame, produced by the combustion of hydrogen gas, issuing, in combination with oxygen, from the compound blowpipe of Hare, be plunged below the surface of a vessel of water, it continues, notwithstanding its submersion in, and actual contact with, this element, *to burn*, apparently with the same splendour as it does in the common atmosphere. The only difference I am able to discover, is, that when the flame burns in the water, it seems, so to speak, to conglobate its figure;—whereas in the air, the shape it assumes, is that of a long slender conical pencil.

You will readily believe that the water, which contains within its bosom, a source of heat so abundant, as hydrogen

gas in combustion with oxygen, will have its temperature rapidly elevated. This was the fact; the thermometer rose, in a very short time, in a common half pint tumbler filled with water, say from 50° or 60° , the temperature prevailing at the time, to 170° and upwards.

The reason why the temperature of 212° was not reached, was this. For the purpose of enabling myself to introduce this gaseous flame, into very narrow recesses, I had affixed to the orifice of the blowpipe beforementioned, a silver tube, about an inch or an inch and a half long; which conveyed the gases, *in a mixed state*, to their orifice of ignition. The diameter of the bore of the tube might be, perhaps, one twentieth of an inch. You are aware, then, under these circumstances, that the flame might occasionally recede, into the interior of the tube, to the place of their conjunction. This I found very frequently to occur in the water; but very seldom in the air. In fact, it often required care to introduce the flame, slowly and deliberately, into the water, in order to avoid recession, at its first entrance. The length of time for which the recession could be avoided, or rather was avoided, even under favourable circumstances, was so short, that I did not attempt any experiment, for the purpose of obtaining specific results.

You will imagine, possibly, that with a heat so energetic as the gases in question are known to produce, the water, especially so small a quantity as half a pint, ought to be expected to boil very soon. But, it should be recollected, that the flame was introduced, commonly, very carefully, and to the depth only of about an inch or so. Little vertical communication of heat would take place; the lateral communication, would probably be still less—more especially when we consider that the water in immediate contact with the flame might be expected to be instantaneously converted into steam and ascend to the surface, which was, to all appearance, the fact. Indeed I was not a little surprised to find that, with the same blow-pipe, and under the same circumstances, water was much more heated by the application of it, for a given time to the exterior of a tin vessel than when the same flame was *submersed* in an equal quantity of the same fluid.

To obviate the evil of the recession of the flame, tubes of a fine capillary bore, so small as to prevent recession, are

necessary. With these through which the gases should be driven, with competent pressure, I have no doubt, it would be possible to maintain an uninterrupted ignition, co-existent with the supply of the gases. In my leisure moments, I am preparing to verify this conjecture ; but as I shall not probably be able to give you the result in time for your next number, I thought proper to offer to your disposal, the little I have already learnt on the subject.

When a piece of cork or pine wood was applied to the submersed gaseous flame, it gave out a brilliant light, producing a pleasing effect on the spectator ; and this phenomenon continued till recession took place, which in some instances might be for a minute or two. Sometimes, however, I observed that the flame was less brilliant than at others. This I attributed either to the imperfect mixture of the gases, or to the excess of oxygen over the hydrogen being less at one time than at another.

Some little experiments I made went to shew, as I thought, that the gases were not perfectly and proportionally mixed. If I caused the submersed flame to burn under an inverted tumbler filled with water, I invariably collected it full of gas, and from a very slight detonation it gave on one or two occasions, I concluded it to be principally, hydrogen.

The metals also were submitted to the submersed flame ; but the most I was able to do with them, was to make a small piece of copper wire, say, of $\frac{1}{8}$ of an inch in diameter, red-hot ; that is red-hot in the day time. And this was repeated with success several times.

You know that the solder which is used in the fabrication of our common tin ware, is very fusible ;—say it fuses at between 300° and 400°, at the highest ; and that the iron which forms the basis of the tin, as it is called, melts at 17 or 18 thousand degrees. Now I had the curiosity to make a comparative experiment. I placed on a common smith's forge, a common tin cup, about nine inches deep, and urged around and beneath it, as great a heat as could be obtained from charcoal, (mineral coal not being at hand,) keeping it supplied with a very small quantity of water, without producing any effect, as you will of course believe, towards melting the solder.

Next I took another small tin cup filled with water, and with my blowpipe applied its flame to its external and vertical surface, at an inch or two below the level of the surface of the water it contained; when in a short time, the metal became heated to redness, next to whiteness, and very soon afterwards a perforation appeared, through which the water escaped and the flame entered. Very soon after the application of the flame, the water boiled violently in the immediate vicinity of the heated metallic surface; it became beautifully luminous, and strange as it may seem, the redness and whiteness of the heated metal as mentioned above, was exhibited, not on the exterior surface of the cup only, *but also on the very surface to which the water was contiguous.* The experiment was often repeated, and with great gratification to the beholders. How great then must be the energy of the hydro-oxygen flame, compared with that of a smith's forge!

This flame also burns beneath the surface of alcohol—but this inflammable fluid has not only the inconvenience of burning on its surface, but in consequence, probably, of this inflammability, is more liable than water is, to recession.

I have thus far detailed the little experiments which have lately amused me and my friends. I am not much disposed to indulge in speculation on the applications, which, in the course of the progress of science, may be made of these facts; yet I cannot refrain from observing, that the possibility of effecting the combustion of most substances, with an agent so energetic as the heat evolved by the gases in question, seems to point distinctly among other things, to their employment as a *sub-marine instrument of naval warfare.* From the experiments I have made, (*and these too, with means having no reference whatever,* to the accomplishment of such a purpose,) I am fully satisfied that success may be commanded, and that, in this respect, it will depend on, and be obtained by, the existence of these three circumstances, to wit:—

1st, On causing the mixed gases to issue from fine capillary tubes, of one or two inches long so as to prevent recession.

2d, On expelling them with such velocity as to cause them to effect a considerable displacement of the water, and

create, as it were, an artificial atmosphere of the mixed gases at the same time that they are in combustion.

3d, On supplying to the combustible body, for instance, that part of a ship's bottom, designed to be attacked, a quantity of oxygen gas, which, aided by the intense heat produced by the ignition of the mixed gases, may combine first with the heated copper, converting it into an oxide ; and 2d, with the carbonized timber of the ship, converting it into carbonic acid gas.

This object, as I have already stated, I am now devoting my leisure moments to accomplish. And this I expect to do, by combining a great number of capillary streams of the mixt gases into a circular flame, in the centre of which, through other capillary tubes, is transmitted, by means of a tube having no communication with the gases in combustion, a quantity of oxygen gas, adequate to the conversion of metals into oxides, and of charcoal into carbonic acid gas.

How far, in the event of the realization of these views, it might be proper to consider it as an instrument of naval warfare to be employed for the perforation of ship's bottoms, so as to sink them in spite of the efforts of their crews, rather than to use it in conjunction with the torpedo, I shall not now pretend to determine. Certain it is, however, in my opinion, that if the *copper* of a ship's bottom were burnt away, even for a small space, it could not be a difficult matter to contrive to enable a person who should have conducted himself in a diving-boat, underneath an enemy's vessel, to drive, by a moderate yet sudden blow, a nail or spike, to which should be attached a torpedo, into the timber of her bottom, and thus effect the intended destruction. Thus, I apprehend, would be overcome the difficulty heretofore experienced in *attaching* a torpedo, by boring or by upward pressure, since pressure can produce no effect—whereas, a sudden blow would, in all probability, effect the desired attachment ; and though the boat would descend by the reaction, this would still be a circumstance of no consequence.

Your most obedient serv't,

THOS. SKIDMORE.

New-York, July 20th, 1822.

ART. XX.—*On the Gales experienced in the Atlantic States of North-America.* By ROBERT HARE, M. D.

[Read May 14th, 1822, before the Academy of Natural Sciences of Philadelphia, from whose Journal it is copied.]

OF the gales experienced in the Atlantic States of North America, those from the north-east and north-west are by far the most influential: the one remarkable for its dryness; the other for its humidity. During a north-western gale, the sky, unless at its commencement, is always peculiarly clear, and not only water, but ice evaporates rapidly. A north-east wind, when it approaches at all to the nature of a durable gale, is always accompanied by clouds, and usually by rain or snow. The object of the following essay, is to account for this striking diversity of character.

When heat is unequally applied to the lower strata of a non-elastic fluid, the consequent difference of density (resulting from the unequal expansion,) soon causes movements, by which the colder portions change places with the warmer. These being cooled, resume their previous situation, and are again displaced by being again made warmer. Thus, the temperatures reversing the situations, and these reversing the temperatures, a circulation is kept up tending to restore the equilibrium. Precisely similar would be the case with our atmosphere, were it not an elastic fluid, and dependant for its density on pressure, as well as heat. Its temperature would be far more uniform than at present, and all its variations would be gradual. An interchange of position would incessantly take place, between the colder air of the upper regions, and the warmer, and of course lighter air near the earth's surface, where the most heat is evolved from the solar rays. Currents would incessantly set from the poles to the equator below, and from the equator to the poles above. Such currents would constitute our only winds, unless where mountains might produce some deviations. Violent gales, squalls, or tornadoes, would never ensue. Gentler movements would anticipate them. But the actual character of the air with respect to elasticity, is diametrically the opposite of that which we have supposed. It is perfectly elastic. Its density is dependant on pres-

sure, as well as on heat, and it does not follow, that air which may be heated in consequence of its proximity to the earth, will give place to colder air from above. The pressure of the atmosphere varying with the elevation, one stratum of air may be as much rarer by the diminution of pressure consequent to its altitude, as denser by the cold, consequent to its remoteness from the earth, and another may be as much denser by the increased pressure arising from its proximity to the earth, as rarer by being warmer.—Hence when unequally heated, different strata of the atmosphere do not always disturb each other. Yet after a time, the rarefaction in the lower stratum, by greater heat, may so far exceed that in an upper stratum attendant on an inferior degree of pressure, that this stratum may preponderate, and begin to descend. Whenever such a movement commences, it must proceed with increasing velocity; for the pressure on the upper stratum and of course its density and weight, increases as it falls; while the density and weight of the lower stratum, must lessen as it rises. Hence the change is, at times, so much accelerated, as to assume the characteristics of a tornado, squall or hurricane. In like manner may we suppose, the predominant gales of our climate to originate. Dr. Franklin long ago noticed, that north-eastern gales are felt in the south-westernmost portions of the continent first, the time of their commencement being found later, as the place of observation is more to the leeward. This need not surprise us, as it is evident that a current may be produced either by a pressure from behind, or by a hiatus consequent to a removal of a portion of the fluid from before.

The Gulf of Mexico is an immense body of water, warm in the first place by its latitude, in the second place by its being a receptacle of the current produced by the trade winds, which blow in such a direction as to propel the warm water of the torrid zone into it, causing it to overflow and produce the celebrated Gulf Stream, by the ejection to the north-east of the excess received from the south-east. This stream runs away to the northward and eastward of the United States, producing an unnatural warmth in the ocean, as well as an impetus, which, according to Humboldt, is not expended, until the current reaches the shores of Africa, and even mixes with the parent flood under the equator.—

The heat of the Gulf Stream enables mariners to ascertain by the thermometer when they have entered it : and in winter this heat, by increasing the solvent power of the adjoining air, loads it with moisture ; which, in a subsequent reduction of temperature, is precipitated in those well known fogs, with which the north-eastern portion of our continent, and the neighbouring seas and islands, especially Newfoundland and its banks, are so much infested. An accumulation of warm water in the Gulf of Mexico, adequate thus to influence the ocean at the distance of 2,000 miles, may be expected in its vicinity to have effects proportionally powerful. The air immediately over the Gulf must be heated and surcharged with aqueous particles.— Thus it will become comparatively light ; first, because it is comparatively warm, and in the next place because aqueous vapour, being much lighter than the atmospheric air, causes levity by its admixture.

Yet the density arising from inferiority of situation in the stratum of air immediately over the Gulf, compared with that of the volumes of this fluid lying upon the mountainous country beyond it, may to a certain extent, more than make up for the influence of the heat and moisture derived from the Gulf : but violent winds must arise, as soon as these causes predominate over atmospheric pressure, sufficiently to render the cold air of the mountains heavier.

When instead of the air covering a small portion of the mountainous or table land in Spanish America, that of the whole north-eastern portion of the North American continent, is excited into motion, the effects cannot but be equally powerful, and much more permanent. The air of the adjoining country first precipitates itself upon the surface of the Gulf, then that from more distant parts. Thus a current from the north-eastward is produced below. In the interim the air displaced by this current rises, and being confined by the high land of Spanish America, and in part possibly by the trade winds, from passing off in any southerly course, it is of necessity forced to proceed over our part of the continent, forming a south-western current above us. At the same time its capacity for heat being increased by the rarefaction arising from its altitude, much of its moisture will be precipitated, and the lower stratum of the south-western current, mixing with the upper stratum of the cold

north-eastern current below, there must be a prodigious condensation of aqueous vapour. The reason is obvious, why this change is productive only of north-eastern gales; and that we have not northern gales, accompanied by the same phenomena. The course of our mountains is from the north-east to the south-west. Thus no channel is afforded for the air proceeding to the Gulf in any other course, than that north-eastern route which it actually pursues.—The competency of the high lands of Mexico to prevent the escape over them of the moist warm air displaced from the surface of the Gulf, must be evident, from the peculiar dryness of their climate; and the evidence of Humboldt. According to this celebrated traveller, the clouds formed over the Gulf, never rise to a greater height than four thousand nine hundred feet, while the table land for many hundred leagues lies between the elevation of seven and nine thousand feet. Consistently with the chemical laws, which have been experimentally ascertained to operate throughout nature, air which has been in contact with water, can neither be cooled nor rarefied without being rendered cloudy by the precipitation of aqueous particles. It follows then, that the air displaced suddenly from the surface of the Gulf of Mexico, by the influx of cold air from the north-east, never rises higher than the elevation mentioned by Humboldt as infested by clouds. Of course, it never crosses the table land which at the lowest is 2,000 feet higher.

Our north-western winds are produced, no doubt, by the accumulation of warm moist air upon the surface of the ocean, as those from the north-east are by its accumulation on the Gulf of Mexico. But in the case of the Atlantic, there are no mountains to roll back upon our hemisphere the air displaced by the gales which proceed from it, and to impede the impulse thus received, from reaching to the shores of Europe. Our own mountains may procrastinate the flood, and cause it to be more lasting and more terrific when it ensues. The direction of the wind is naturally perpendicular to the boundary of the aquatic region producing it, and to the mountainous barrier which delays the crisis. The course of the North American coast is, like that of its mountains, from north-east to south-west, and the gales in question are always nearly north-west, or at right

angles to the mountains and the coast. The dryness of our north-west wind may be ascribed not only to its coming from the frozen zone, where cold deprives the air of moisture, but likewise to the circumstance above suggested, that the air of the ocean is not like that of the Gulf, forced back over our heads to deluge us with rain.

Other important applications may be made of our chemical knowledge. Thus in the immense capacity of water for heat, especially when vaporized, we see a great magazine of nature provided for mitigating the severity of the winter. To cool this fluid, a much greater quantity of matter must be equally refrigerated. Aqueous vapour is an incessant vehicle for conveying the caloric of warmer climates to colder ones. Mistaking the effects for the cause, snow is considered as producing cold by the ignorant; but it has been proved that as much heat is given out during the condensation of aqueous vapour, as would raise twice its weight of glass to a red heat. Water, in condensing from the æri-form state, will raise ten times its bulk one hundred degrees. The quantum of caloric which can raise ten bulks one hundred degrees, would raise one bulk one thousand degrees nearly (or to a red heat visible in the day) and this is independent of the caloric of fluidity, which would increase the result.

Further, the quantum of heat which would raise water to 1000, would elevate an equal bulk of glass to 2000. Hence we may infer, that from every snow, there is received twice as much caloric as would be yielded by a like stratum of red hot powdered glass.

It is thus that the turbulent wave, which at one moment rocks the mariner's sea-boat, on the border of the torrid zone, transformed into a cloud and borne away towards the arctic, soon after supports the sledge or the snow-shoe of an Esquimaux or Greenlander; successively cooling or warming the surrounding media, by absorbing or giving out the material cause of heat.

ART. XXI.—*Notice of Magnetic effects produced* by Dr. Hare's Calorimotor; by GEORGE T. BOWEN, of Providence.*

IN Vol. V. p. 352 of the *Edin. Phil. Journal*, is a description of an electro-magnetic apparatus by Prof. Moll of Utrecht. After having given a description of the instrument, that gentleman observes, "A remarkable feature in the effect of this spiral voltaic apparatus, is the strong adhesion of iron filings to the conductive wire. If the zinc plate be new, or well cleaned, the acid strong, and of course the galvanic process going on with energy, then if iron filings, on a paper, are brought backward and forward, under, and near to the horizontal conductive wire of copper, the iron filings will begin to stand erect as if in the vicinity of a load-stone, and they will even adhere strongly to the copper wire when brought into contact with it." These observations appearing to me to be interesting, I was desirous of seeing what would be the effect produced by presenting iron filings to the wire which connects the opposite poles of the calorimotor of Doct. Hare. The results of the experiments which were performed with this instrument are as follows:—A large copper wire, about one foot in length, was bent in the form of a semi-circle, and its ends connected by means of small vices to the opposite poles of the calorimotor. The instrument was then immersed in the weak acid solution. On bringing a paper containing iron filings into the vicinity of the copper, which had already become hot, the filings began to stand erect, and when brought into contact with the wire they were powerfully attracted by it; adhering to it, and forming a fringe upon its surface. The calorimotor was then raised out of the diluted acid, and it was observed that the filings dropped from the connecting wire, the instant the instrument left the surface of the fluid. This experiment was often repeated; (the size of the connecting wire being varied,) and always with the same results. A platina wire was then bent as in the above experiment, and its ends connected with the opposite poles of the calorimotor. Upon immersing the plates, and bringing the iron filings on a paper, near to, and into contact with the platina, they were powerfully attracted, and

* In the laboratory of Yale College.

adhered to the wire as in the preceding experiment. The instrument being then raised from the diluted acid, the filings fell from the wire. These experiments were repeated, and varied by employing different metals to complete the communication between the two galvanic poles. Wires of iron, copper, brass, lead, zinc, silver, and platina were used; the length of the wire employed being in all cases so regulated, that although it became hot, it was not ignited. In every instance the same magnetic properties were exhibited by the connecting wire; the iron filings being strongly attracted by it, so long as the calorimotor was immersed in the acid solution, and immediately falling from it when the instrument was raised from the fluid.

In Vol. VI. p. 83 of the work above quoted, are detailed some experiments of Prof. Moll, in which he succeeded in imparting magnetism to steel needles by inclosing them in a glass tube, about which was wound a spiral of brass wire, and passing *strong electrical discharges* through the spiral. These experiments were repeated in the following manner: Around a glass tube one quarter of an inch in diameter and four inches in length, was wound spirally, a brass wire, from *left to right*, forming ten spirals. The ends of the wires were then connected with the opposite galvanic poles and a needle, which had been previously ascertained to be free from magnetism was placed within the tube. The instrument was then immersed and remained in the fluid for thirty seconds. Upon examining the needle after the plates had been raised from the acid solution, it was found to have become powerfully magnetic, having a north and south pole; one of which was attracted and the other repelled by the poles of a magnetic needle suspended in the usual manner—they also took up iron filings abundantly. The end of the needle which had been placed nearest to the copper or negative side of the calorimotor had acquired north polarity, while that which had been next to the zinc or positive side had acquired south polarity. This experiment was often repeated, and always with the same results; the end of the needle placed nearest to the copper plates constantly acquiring a north polarity.

One of the needles which had been magnetized in this manner, was again enclosed within the glass tube, its *north pole* being placed next to the copper side of the apparatus. The plates were immersed, and again raised from the fluid.

Upon removing the needle, its poles were found to have been unaffected, the end which had been nearest the copper, still retaining its north polarity. The same needle was again submitted to the galvanic action, its *north pole* being now placed nearest to the *zinc plates* of the instrument; upon examination, its poles were found to be reversed; its south pole which had been placed nearest the *copper* plates, had acquired north polarity, while its *north pole* which was next to the *zinc* plates had acquired south polarity.

A *common magnetic needle* was then enclosed in the tube, its south pole being placed next to the copper side of the apparatus. The plates having been immersed the usual time, the needle was examined. The end which had previously been its south pole, and which was placed next the copper plates, had now acquired north polarity, and in every instance that end of a needle which was connected with the negative side of the calorimotor became its north pole, so long as the spiral brass wire upon the glass tube was wound from *left to right*. I then took the same glass tube and wound a brass wire spirally around it, the spirals however, being now wound from *right to left*. A needle was placed within the tube, and the ends of the spirals connected with the opposite poles of the calorimotor. After the immersion of the plates, the needle was removed from the glass tube and was found to have become magnetic—its *north pole* being that end of the needle which had been connected with *zinc plates* of the instrument, and vice versa. The needle was then again enclosed in the tube and the plates immersed; its acquired south pole being placed in connection with the *zinc* plates. When examined, its poles were found to be reversed; its former *south* pole which had been connected with the *zinc* plates having now acquired *north polarity*; and in all cases, that end of a needle which was connected with the *zinc* plates of the instrument, acquired *north* polarity, when the spirals about the glass tube were wound from *right to left*.

A steel needle free from magnetism, was then enclosed within a tube of glass four inches long and an eighth of an inch in diameter. This glass tube was then placed within a tube of lead, and the lead tube again enclosed in one of glass, around which was placed a spiral of brass wire, wound from *left to right*; the ends of the spirals being connected with the opposite galvanic poles—The plates were immersed and suffered to remain in the fluid during half a minute

The needle on examination, was found to have become magnetic; its *north pole* being that end of the needle which had been connected with the copper or negative side of the calorimotor. It was again enclosed in the tube as before; the end which had acquired *north* polarity being now placed next to the *zinc* plates. After the immersion of the instrument, the poles of the needle were found to be reversed--the former south pole having now acquired north polarity, and vice versa--the results obtained in this method of operating were always the same; the needle acquiring *north* polarity at the end which was placed nearest the *copper* plates, while the spirals of brass around the glass tube, passed from *left to right*. When the direction of the spirals was changed, and the brass wire wound about the glass tube from *right to left*; then, that end of the needle which was connected with the *zinc* plates always acquired north polarity. Being desirous of ascertaining how long it was necessary the plates should be immersed in order to produce these effects, a needle was inclosed in the tube as in the former experiments, and the plates were then immersed, and *immediately* withdrawn from the fluid. On examination, the needle was found magnetic. Another needle having been placed within the tube, the calorimotor was lowered until the plates had descended into the fluid *one quarter of an inch*, when it was instantly raised. Even in this instance, when the plates had descended only *one quarter of an inch* into the acid solution, and had remained there only *one second*, the needle was found to have become powerfully magnetic, and readily took up iron filings. This experiment was often repeated, and with the same results. The preceding experiments lead to the conclusion, that when a needle is subjected to the galvanic action in the manner above described, it instantly becomes magnetic, and that end of the needle which is connected with the *copper or negative* side of the calorimotor, always acquires *north* polarity, when the turns of the spiral about the glass tube pass from *left to right*; and that end connected with the copper plates always acquires a *south polarity* when the turns of the spiral pass from *right to left*.

From these experiments it appears that the same magnetic effects are produced by Dr. Hare's calorimotor, as by powerful electrical batteries—although he justly considers his instrument, as producing a great flow of caloric almost without electricity.

ART. XXII.—*Fusion and Volatilization of Charcoal, by the EDITOR, with remarks on these experiments and on the Galvanic Instruments of Dr. Hare, by Professor JOHN GRISCOM, of New-York.*

ON page 108, of the present volume of this Journal, is mentioned the fusion of charcoal by Professor Hare's Deflagrator. The experiments have been since frequently repeated, with results uniformly the same. A stronger acid has been employed in some of the experiments, and the effects were more rapid and brilliant. The elongation of the charcoal point of the zinc pole was more sudden and extended to a greater length than before. It accumulated in an instant, to the length of a quarter of an inch, and nothing seemed to hinder its acquiring double that length, except the difficulty of holding the points so accurately, as to prevent their striking against one another, and thus detaching the projecting mass of melted charcoal. During the fusion, if the points touch, they adhere. On the copper pole the formation of the crater shaped cavity was equally sudden and rapid. It was also deeper and larger than in the former trials.

Whenever the point of the zinc pole was moved to a new place, the cavity instantly appeared there, and thus the number of cavities was increased at pleasure.

With a Deflagrator of considerable size, and in good order, these experiments are, in fact, extremely easy, and with charcoal well prepared, will never fail in a single instance.* All the results obtained in the former trials were not only confirmed, but were in every respect more striking and pleasing. The surface of the fused charcoal was brilliant, with a metallic and frequently iridescent lustre, and the whole appearance was so changed, as to justify the assertions in the former communication, that the melted substance would never have been suspected, from its appearance, to have had any connection with charcoal. Upon the charcoal on the copper side, there was no appearance of fusion; the crater-shaped cavity was extremely well defined and brilliant, with the proper fibrous and porous ap-

* Prepared charcoal may be boiled afterwards in water, and will still conduct between the poles and melt as above.

pearance of charcoal; every thing indicates that the charcoal is wasted from this pole, and is transferred to the other. It seems to pass, in the state of vapour, to be accumulated or condensed on the positive pole by attraction, and then to undergo a fusion by intense heat. It is nothing new in chemistry that a substance should be vaporised first, and fused afterwards. In this instance, however, it is very possible that the charcoal begins to be melted at the copper pole, but is simultaneously carried by a strong current, or attraction to the zinc pole, and being there detained by the same cause undergoes a new and more complete and accumulating fusion. It does accumulate with surprising rapidity, three seconds being sufficient to produce a decided result.

In order to ascertain whether the air had any agency in producing these effects, the charcoal points were made to communicate in a small glass globe filled with nitrogen.* The light was thought to be even more brilliant than before—the whole globe appeared as if a ball of fire, and the growth of the zinc pole and the fusion of the charcoal, were equally rapid and complete, as in the former instances.

The fused charcoal sinks readily to the bottom of strong sulphuric acid. Common charcoal floats upon rain water, with at least half its volume out—we are therefore, justified in concluding that the specific gravity of charcoal is increased at least four times by fusion, and it also becomes much harder.

Its properties appear to be altered in other respects. It becomes so incombustible that when ignited on a red hot iron plate with free access of the air, it remains for a long time unaltered, while pieces of common charcoal placed contiguously, burn rapidly; the fused charcoal eventually wastes away although with extreme slowness, but without the ordinary appearances of combustion, and leaves a small porous residuum of a yellowish gray colour.

It will occur to every reader, that this combustion ought to be performed in close vessels, in order to ascertain whether the product is any thing else than carbonic acid. This trial has been made, the product was nothing but carbonic acid, and therefore we are authorised to say that the fusion evolves no new form of matter, metallic or otherwise—and

* It was prepared by phosphorus over mercury, and stood 17 hours over fused muriate of lime.

that the fused substance is nothing else than carbon in an extremely condensed state; with a specific gravity superior to that of the Anthracite, equal to that of the heaviest Plumbago, and in some degree approximating towards that of the diamond.

The experiment upon which this conclusion was founded, was as follows. Several pieces of the fused charcoal were placed on a small fragment of brick; this was floated in a dish of mercury, and the whole was covered with a small bell glass filled with oxygen gas, obtained over mercury. A burning lens of one foot in diameter and eighteen inches focus, at noon, with a bright sky, (Aug. 29) was made to throw the concentrated rays of the sun, upon the melted charcoal. There was no appearance of combustion, that could be distinguished by the eye, in the bright light of the focus, but, the substance wasted very slowly away, and at length disappeared *leaving no residuum*. The gas, examined in the usual way, gave carbonic acid, mixed with an excess of oxygen gas, which, after the carbonic acid was removed, sustained combustion as it usually does when pure. The heat of the lens had been so intense as to fuse and vitrify the surface of the brick support.

Strong sulphuric acid boiled upon the fused charcoal produces no effect, while with the common charcoal (as it is well known) it is decomposed. The strongest nitric acid in the cold does not affect the melted substance, and even with the aid of a boiling heat, the effect is only slight, and ceases immediately when the heat is withdrawn.

The most interesting of these experiments have been repeated in the presence of Bishop Brownell,* and of Professor Griscom who were well satisfied with the results.

Many specimens of the melted charcoal have been submitted to the inspection of Dr. Hare, who is of opinion that they have undergone a true fusion. This gentleman has also so far repeated the experiments mentioned in the former communication, as to be entirely satisfied of their correctness.

* Formerly Professor of Chemistry in Union College, Schenectady.
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Dr. Hare's Calorimotor.

Since the publication of our last number, we have through the kindness of Dr. Hare, obtained this fine instrument, constructed under the direction of the inventor, on a large scale, and in the most perfect manner. We cannot now do any thing more than to say that we find all Dr. Hare's statements fully confirmed.

The facilities which this instrument affords for exhibiting the new and interesting phenomena of magnetism, as produced by Galvanic Instruments, are, we believe, unequalled, particularly in imparting a very powerful magnetic virtue to needles and in causing Iron filings to be taken up readily by wires and strips of all sorts of metals—whether Iron* form a part of the connection or not. We have also been much struck by the permanency of the action of the Calorimotor. The same diluted acid continues to ignite large wires for many weeks in succession, and with slight additions of fresh acid to the fluid, the full effects are at any time easily renewed.

Extract of a letter from Prof. JOHN GRISCOM, dated August 26, 1821, to the Editor.

It gives me pleasure to acknowledge that the experiments which, in company with Bishop Brownell, I had the pleasure of witnessing in the laboratory of your college on the 9th inst. went to confirm in the most satisfactory manner, the statement made in the last number of the Am. Journal relative to the power and operation of Dr. Hare's Galvanic Instruments. The rapidity with which the Calorimotor causes the ignition and even fusion of an iron wire some inches in length, and as thick as a goose quill, and the beautifully variegated coruscations of the burning hydrogen kindled by the ignited wire, and the play of the flame on the surface of the liquid after the plates are raised out of the trough, rendered this experiment at once, one of the finest exhibitions that can be made to a class. It is surpassed by nothing but the overpowering brilliancy of the Deflagrator. The effect of this instrument upon two pieces

* See the annexed paper.

leaving no doubt upon the mind of either of us who witnessed for the first time the operation of this new machine, that the charcoal was not only *fused* but *volatilized*; at least the piece that was connected with the negative pole of the battery. No sooner had the ignition completely taken effect than it was discovered on stopping the action, that instead of a point on the end of the negative charcoal, a cavity or crater of considerable extent had been formed, the edges of which were pointed or jagged. The piece attached to the positive pole on the contrary was increased lengthwise by a cylindrical protuberance, which, when the operation was protracted, grew thicker at the extremity, acquiring an irregular knob, the surface of which was compact, smooth and glossy, resembling not a little in appearance, the surface of hematitic iron ore. The extent of this projection corresponded with the depth of the cavity in the other piece, so as to leave no room for doubt that the thoroughly ignited matter of the negative piece had been transferred by the power of the electro-calorific current to the positive charcoal; and the appearance of the surface, especially when viewed with a magnifier, indicated the *fusion* of the transferred portion. There was, it is true, no *direct* evidence of liquifaction; and it is, I conceive, *possible* that the carbonaceous matter may have been volatilized, and again condensed, without that intermediate change, as in the case of many other solid substances by heat. But, however that may be, the phenomenon, as it respects the charcoal, is different from any thing that has heretofore been published, and it furnishes an additional and striking instance of the power of the voltaic current, and of the superior efficacy and convenience of Dr. Hare's instruments. The entire absence of insulation between the adjacent pair of plates, and the great facility with which their immersions and emersions can be effected, will doubtless give this ingenious modification of the galvanic apparatus a decided superiority over every other. The fluid employed in the experiments above mentioned, had, I think you informed me, remained in the troughs several weeks or months. The new deflagrator, described by Dr. Hare in the last No. of the Journal, which I had an opportunity of seeing at the college in Providence, is still more convenient. In that, the plates remain fixed,

of well prepared, and pointed charcoal was truly interesting, while the troughs are raised and lowered by levers which are easily moved by placing the foot on a treadle.

ART. XXIII.—**Additional facts respecting the Condrodite and its identity with the Sparta mineral. (Maclureite of Seybert, Brucite of Cleaveland,) in a letter addressed to the Editor, dated Philadelphia, August 26, 1822.*

SIR,

SINCE my communication concerning the *Maclureite* was transmitted to you, I observed, in the *Annales des Mines*,† a memoir by the late Professor Haüy on the *Condrodite*. By crystallographical investigation he identified that substance with the mineral found near Sparta, N. Jersey; he states, that Berzelius arrived at the same determination by Analysis, and that he considered it a *Silicate of Magnesia*. From the above statement, it was evident to me, that some error existed with regard to the composition of these substances, because the experiments, related in my paper concerning the *Maclureite*, unequivocally prove the presence of fluoric acid in the mineral found in New-Jersey. As the celebrated Swedish Professor announced the chemical identity of these substances, without his having detected Fluoric Acid,‡ I was induced to procure some of the mineral from Finland, and obtained a small quantity of it. The specimen was brought from Sweden by Mr. William Maclure; it was imbedded in a gangue of Carbonate of Lime, associated with blue Spinelle, and a greenish mineral resembling Pargasite; from these substances it was, as much as possible, separated by mechanical means. To free it entirely from the Carbonate of Lime it was boiled with Acetic Acid, the residue, after this treatment, weighed 1.20 grammes, it was calcined at a red heat. during one hour, in a platina crucible, with six times its weight of crystallized sub-carbonate of Soda, the matter after calcination was treated with

* Received too late for insertion with Mr. Seybert's Analogies.—*Ed.*

† *Annales des Mines*, Tome, C. p. 527. et sequen.

‡ See *Journal of Royal Institution of G. B.* for 1822. No. 24.

water, and the solution was filtered to separate the insoluble residue ; Acetic Acid in excess was added to the filtered liquor ; by means of Ammonia, it proved to have retained no Silica ; the solution was freed from Carbonic Acid by supersaturation with Acetic Acid and subsequent ebullition, the excess of Acetic Acid was neutralized with Ammonia, and the solution was treated with Muriate of Lime ; this occasioned a white flocculent precipitate, which, when heated with concentrated Sulphuric Acid, disengaged vapours, having the odour of Fluoric Acid, and they corroded glass with energy ; therefore this precipitate was Fluuate of Lime. It was out of my power to estimate the quantity of Fluoric Acid contained in the mineral, owing to the small quantity I had at my disposal, more especially as it was intimately intermixed with blue Spinell and Pargasite. From the preceding facts I do not doubt, if the mineral from Finland be again examined, it will prove to be a Fluo-Silicate of Magnesia, and that the two substances in question must, as such, be hereafter ranked in our Mineralogical systems.

I submit this letter for publication in the next number of your interesting Journal.

And am, very respectfully,
Your obedient servant,
H. SEYBERT.

ART. XXIV.—*Obituary.*

PROFESSOR FISHER.

PERHAPS most of our readers are apprized of the fact,—that Professor Fisher was among the number of those, who perished in the wreck of the Albion, on the morning of the 22d of April last.

Soon after the news of the death of Professor Fisher was confirmed, an Eulogy embracing the principal circumstances in his life and character, was delivered in the College Chapel, by Professor Kingsley : and the parts of the following account which are marked by inverted commas, are taken from that performance.

"ALEXANDER METCALF FISHER, late Professor of Mathematics and Natural Philosophy in Yale College, was born in Franklin, Massachusetts, in the year 1794, July 22; the oldest child of his parents, who still live to mourn, with their remaining children, his untimely death. Of his childhood and early youth, it may be sufficient to state, that he soon discovered an aptitude for learning, and a strong desire for a public education,—a disposition which his parents very wisely determined to foster and indulge. After completing the preparatory course of study, he entered Yale College in the year 1809. Here he was immediately distinguished for his sobriety, his diligence, his scrupulous attention to all the regulations of the College, and his rapid advances in the studies of his class. So early did his real character as a scholar unfold itself, that in the very first term of his college life, he took a place among his companions, where he saw no superior,—a station which he never relinquished."

"It deserves, likewise, to be here mentioned, that he early gave evidence of an independence of mind, a disregard of the opinion and practices of others where they at all interfered with his own views of right,—as honourable as it is rare, and which, perhaps, more than even his native sagacity and penetration, contributed to his success as a scholar. If he wished to secure the approbation and esteem of those around him, he knew well, it was not to be sought by connivance at faults or base compliance with corrupt solicitations, but to be commanded by a resolute performance of his duties as a member of the institution, and a strict obedience to the dictates of his own conscience."

"At every exercise, whether recitation or lecture, he was always present, always attentive, and always prepared."

"Yet in this exact and punctilious attention to his duties as a student, he was never, it is believed, suspected by any one of his companions to be influenced by unworthy motives:—the honours of College were his right; every one admitted his deserts; he looked for no favours, and practiced no artifice. His preeminence in scholarship caused no relaxation of his efforts. His industry was unremitted; and his attachment to knowledge seemed strengthened as his acquisitions increased."

"While an undergraduate, he excelled in every part of collegiate study, but was, perhaps, most distinguished in the branch of pure and mixed mathematics; for progress in which he was peculiarly qualified by the rapidity of his perceptions, and habits of close, and long continued attention; which enabled him, with apparent ease, to trace quantities in their remotest relations, and disentangle the most complicated theorems. That he would be eminent in this department of science, was then easily foreseen; if his future situation in life should be such, as to allow him an opportunity to cultivate his favourite studies. He received his Bachelor's degree, in the year 1813, and left the College with a reputation, which few at the same period of their literary life, have attained; a reputation created by nothing casual or adventitious, and which did not exceed his merits.

"The two years which followed, he spent partly in his native town in attending to moral and metaphysical science, and partly in commencing a theological education at the Seminary in Andover. In the year 1815, he was elected to the office of Tutor in Yale College, a place for which he was known to possess the highest qualifications, and in which no doubt was entertained he would contribute, in the full proportion of his talents, to the usefulness and reputation of the seminary. Nor were the expectations which the friends indulged of his success, in any respect disappointed. He at once engaged in all the duties of his station, both as an instructor and a governor, with a readiness, an ability, and a devotion to his object, which soon satisfied those, who had an opportunity to observe his progress, that great as was his capacity for the acquisition of knowledge, his talent for communicating it to others, and for distinction in the whole routine of academic life, would not be less conspicuous.

"In the year 1817, he was elected Adjunct Professor of Mathematics and Natural Philosophy in the College, and in 1819, entered upon the full duties of his office. From the moment he was designated to this place, all his views, wishes and exertions seemed directed to the single object of qualifying himself for the entire discharge of its obligations. His ambition looked to no other station of usefulness and distinction; he well knew his own peculiar talents, and that here was the station where he could exert himself the most successfully and honorably. From the time of his gradua-

tion, though his studies had been chiefly directed to theological and moral inquiries, yet he never relinquished his attention to his favorite mathematics, nor much abated his attachment and zeal for natural science. The consequence was, that though young for so responsible an office as the Professorship of Mathematics and Natural Philosophy in Yale College, yet his attainments were universally thought by the friends of the institution to be adequate to the place: and those who were best acquainted with his habits of study and his actual acquirements, were the most confident of his success.

“As his prospects for life had now changed, his studies were accommodated to his new situation; without, however excluding those subjects of moral science, which had received so much of his attention, and whose importance and value he had so justly estimated. He immediately entered, with all the ardor of youth, and the zeal inspired by a favorite pursuit, upon a plan of mathematical and philosophical study, embracing every topic of these enlarged sciences, in their widest extent. With what success he prosecuted his design, is well known to most of this audience. In the time which elapsed from his election to his new office, to his departure for Europe, he had examined and digested the writings of the principal philosophers of Britain, tracing every discovery, theory, and illustration to its source; and had read, with the same attention, many of the most valuable publications of the mathematicians and philosophers of France. He had, in the same time, prepared a full course of lectures in Natural Philosophy, both theoretical and experimental, which for copiousness, clearness, and exact adaptation to the purposes of instruction, equalled the highest expectations of his friends. Having thus far accomplished his original design, he resolved on an excursion to Europe, not so much for the sake of making new acquisitions in science,—for the knowledge of European philosophers is found in their books,—as to visit the places of public instruction, and examine by actual inspection the modes of communicating knowledge in the foreign universities,—to form an acquaintance with men who were distinguished in his own department,—and to obtain such information as might enable him more fully to aid in raising the scientific character of his country, and in promoting

the usefulness and prosperity of his college, to the interests of which he was entirely devoted. Every preparation was made which was thought necessary to secure the attainment of his object ;—and after the fullest inquiries and taking the best advice, he embarked at New York, for Liverpool, on board the Albion packet ; where, to use his own language, in the last communication received from him, “ every thing seemed to promise a quick, safe and agreeable passage.”—On the first of April last, he left his country, full of animation and zeal, and attended with the ardent wishes of his friends for the success of his enterprize.”

It appears from a comparison of the several accounts which have been published of the loss of the Albion,—that, for the first twenty days after leaving New York, the weather was moderate and favorable ; and that about one o'clock on the afternoon of Sunday the 21st, the ship made the south of Ireland. Soon after a gale commenced, which blew the remainder of the day with great violence. About half past 8 o'clock in the evening, the Albion shipped a heavy sea, which threw her on her beam ends, and took the mainmast by the deck, the head of the mizenmast, and fore topmast, and swept the decks clear of every thing, including boats, compasses, &c. and stove in all the hatches, state-rooms and bulwarks in the cabin, which was nearly filled with water. At the same time, six of the crew, and one cabin passenger, Mr. Converse of N. Y. were swept overboard. The axes being lost, no means remained of clearing the wreck, and the ship was unmanageable. About three o'clock, the ship struck on a reef of rocks about one hundred yards from the main land. This, as afterwards appeared, was in Court-macsherry-Bay, about three miles west of the old head of Kinsale. In about half an hour the ship went to pieces ; and all the cabin passengers except Mr. W. Everhart of Chester, Pennsylvania, were lost. It is understood that Prof. Fisher, as well as some others, was considerably injured when the masts were carried away ;—and at the time the other passengers went on deck, after the captain had informed them of their imminent danger, he remained below in his birth. Whether he afterwards came up, and what were the particular circumstances of his death, is unknown.

The character of Prof. Fisher is thus drawn by the author of the Eulogy.

"The character of Professor Fisher, such as it appeared to me from familiar acquaintance and long observation, I should fear to delineate in any other place than this,—where there are so many who can testify to the justness of the description, and shield me from the charge of fanciful and extravagant panegyric. But here I do not hesitate to exhibit it as it was,—in perfect confidence, that what I say will receive the fullest attestation from those who hear me.

"I have already alluded to the quickness with which he apprehended the most remote truths: but rapid and almost intuitive as were his perceptions, no one could be more free from the fault of precipitate judgment. Caution, no less than activity, constituted a prominent feature of his mind; and on whatever subject he had formed an opinion, seldom could a difficulty be suggested, which he had not foreseen, or an objection which he was not prepared to remove. To this union of a cautious and quick judgment, of ready decision and prudent wariness, no doubt the scheme of study, which he early adopted, and to which he constantly adhered, very greatly contributed. Whatever book he read, it was the subject of which it treated, that received his first and principal attention. He examined the statements and reasonings of an author, less to know his peculiar views and manner of unfolding them, than to aid his own investigations, and obtain materials for thought and reflection. Hence, while he was familiar with books within the range of his studies, and minutely acquainted with the opinions and reasonings of others, he preserved his independence of mind. The operations of his understanding were very little liable to be embarrassed with conflicting opinions, adopted at different times, with equal confidence. He was enslaved to no system, was fascinated with no work on account of its antiquity or its novelty,—he brought the merits of a writer to the standard of his own intellect,—and his judgment, though soon formed, he seldom found reason to vary.

"With a mind so unshackled, he was in a high degree prepared for original investigation: and here perhaps was to be found his most distinguishing characteristic. Whatever subject he examined, he was almost certain to find

some new method of supporting or illustrating truths already known, or by the aid of discoveries already made, to advance to some new and more remote conclusion.

“As might be expected, he was confident in his own opinions,—but not impatient of contradiction; he was always candid and ingenuous,—asserted his own views without dogmatism, and defended them without obstinacy. His deportment, on all occasions, was unassuming and modest, marked with no pretension, and the farthest removed from ostentation or display. If in the society of his friends, or in more enlarged circles, he conversed on subjects connected with his peculiar pursuits, these were never topics of his own selecting, but introduced by others. His studious and retired habits may have given him among those who imperfectly knew him, the appearance of reserve; yet among his familiar acquaintance, his disposition seemed frank and open, his affections warm, and he discovered those qualities which are usually thought to prepare, in a high degree, those who possess them, for social and domestic life.

“As to the extent of his scientific and literary attainments, the proofs he has given of eminence in mathematical and physical knowledge, leave no room in this department for doubt or hesitation. Whoever has watched the progress of his studies, or the course of his instruction, or has examined his communications to the public, will need no further evidence of talents and acquisitions in his own peculiar province, of the first order. But his researches, as before intimated, were not confined to mathematics and physics. The philosophy of the mind was likewise his favorite study. He was familiarly acquainted with the writings of the most distinguished metaphysicians, and had examined with the closest scrutiny, their various reasonings, speculations and theories. If his knowledge of the exact sciences qualified him to pursue with uncommon advantage the evanescent and less easily defined objects of intellectual philosophy,—his knowledge of the laws of the human mind, its capacity, and the proper region for the exertion of its powers, was no less useful in directing and regulating his physical inquiries. This rare union of two kinds of knowledge so different, and the want of which union has so often been attended with injury to both, was considered by the friends of Professor Fisher as constituting one of his chief excellencies,

and affording the surest promise of future usefulness and distinction. Besides his acquirements in the branches of knowledge already mentioned, and which formed, no doubt, his favourite subjects of research, he ever continued to cultivate a taste for classical learning, was familiar with the literature of England and France, and, indeed, there are few topics of miscellaneous knowledge, to which, with his great industry and exact method in the employment of time, he had not been able to give a portion of his attention.

“What he was as an officer of this College, is best known to his brethren of the immediate government and instruction;—and to them particularly, I would appeal for the truth of the declaration,—that here he was a model of integrity and faithfulness, which it would be well for all in similar stations to imitate, but which few can hope to excel. Who ever knew him neglect or decline any duty? The interests of the institution, were with him, the primary object of attention and regard. To know those who were under his government and instruction, and to be known by them; to encourage the studious, and to expose the negligent and the vicious; to unite firmness and discretion, a due regard to the circumstances of individuals, with an impartial execution of the laws, was his constant aim, and formed the distinguishing traits of his academic character.

“I have only to add,—that to his other qualities, was united a deep sense of religious obligation. All his conduct seemed marked with an exact and unvarying conscientiousness. Few have manifested a higher reverence for the divine law, or failed less in their obedience to the precepts of the gospel.

“Such is an outline of the character of him we have lost. He was one whose talents and acquisitions we deservedly held in the highest estimation; one who was an ornament to this College, and seemed destined by his zeal and activity, and the boldness and success with which he entered on the most arduous courses of scientific research, to be an honor to his age and country. But he is gone: and it becomes us to submit without murmuring, to this severe, and to us mysterious dispensation, of a righteous providence. But though resignation is our duty, neither the principles of true philosophy, nor the precepts of christianity, forbid us to unite with his numerous friends, and, especially, with his

parents and other relatives, in mourning his early departure. The best feelings of our natures, the kindest affection of our hearts, are expressed in our tears; and the Saviour himself, wept at the death of his friend. Long will it be, before the event we this day deplore, shall be recollected within these walls without the deepest sorrow;—or the name of him we have lost, be here mentioned without awakening the tenderest sympathy.”

The articles furnished by Professor Fisher for this Journal are the following.

Essay on Musical Temperament. Vol. I.

Remarks on Dr. Enfield's Institutes of Natural Philosophy. Vol. III.

On some recent Improvements in the construction of the Printing Press, &c. Vol. III.

On Maxima and Minima of Functions of two variable Quantities. Vol. V.

Among articles furnished by him for other works, the following may be mentioned—

Solutions of various Mathematical Questions, under the signature X, in the “American Monthly Magazine,” commenced in New York, in the year 1817. Among these, the solution of a Prize Question, proposed by Professor Adrain, as to *the most advantageous position of the sail of a windmill, when the ratio of the velocities of the sail and wind is given*, is deserving of particular notice.

Solutions of various questions under the signature of Nov-Anglus, in Leybourn's Mathematical Repository.

Observations on the Comet of 1819, and calculation of its orbit, in the fourth volume of the Memoirs of the American Academy of Arts and Sciences.

I cannot dismiss the subject of the preceding notice, without adding my own testimony to the merits of my lamented friend and coadjutor, Professor Fisher. It is natural to dwell, with fondness, upon the character of a departed friend, and the more so, when a sudden and tragical death

has separated him from us. But, after making every proper deduction on this account, I can truly say, that Mr. Fisher was the most extraordinary man of his years, whom I have ever known. Acquisitions, equal to his, at the age of twenty eight, I have never seen; nor a more vigorous and acute intellect at any age. His moral characteristics—founded on the elevated principles of the Christian religion, which he fully embraced—were distinguished for unsullied purity and inflexible integrity. To his extraordinary scientific attainments, he added the finish of classical and polite literature, derived from the best ancient as well as modern sources; his elegant taste embraced the fine arts in their extent and variety, and he was satisfied with nothing, even in the decorum and accommodations of private life, which was not adapted to the same elevated standard. In the management of this Journal—for the support and prosperity of which he ever manifested a warm zeal—he was an important auxiliary; and no other opinion was ever thought necessary, when he had once given his, (which was often asked,) especially on subjects of mathematical and physical science. Perhaps, it is not improper to add, that, at a period, when, from the failure of health, it appeared probable that the Journal must either be relinquished, or pass into other hands, Professor Fisher, was the man who would have been depended upon to assume that responsibility.

His projected scientific and literary tour, excited in my mind the strongest interest—it commanded such efforts as I could make for the promotion of his object, and I looked forward with high raised hopes and expectations, to the period of his return, when, I doubted not, he would bring back with him, the richest harvest of knowledge, unalloyed by any thing that could give pain to the most affectionate and to the purest of his friends. But it pleased the Almighty to dash him upon the rocks, and to overwhelm him in the ocean, at the moment when Europe, so long and so ardently desired, had just broke on his view!

A few of his personal friends in this place, have procured an excellent portrait of him to be painted by an eminent artist,* and to be hung in the room which was lately the scene of his labours and instructions. An engraving† of it is prefixed to this number.

EDITOR.

* Mr Sam. F. B. Morse.

† By Mr. S. S. Jocelyn.

INTELLIGENCE AND MISCELLANIES.

I. Foreign Literature and Science.

1. *Analysis of an Ore of Silver.*—An Analysis of Antimoniated Sulphuret of Silver, (Red Silver,) has recently been made in the laboratory of M. Berzelius at Stockholm, by P. A. de Bonsdorf, Adjunct Professor of Chemistry, at Abo. According to Klaproth, this mineral contains :—

Silver	60
Antimony	19
Sulphur	17
Oxygen	4

100

Proust makes it contain, 3 per cent. of Oxide of Iron, 3 of Sand, and 3 of Water,—6 loss.

The process of Bonsdorf appears to have been carefully conducted, and his result is—

			Oxygen.	Sulphur.
Silver	58.94	} which would {	4.36	8.768
Antimony	22.84		4.19	8.423
Sulphur	16.61			
Earthy substance	.30			
Loss	1.31			
	100.			

In reflecting on this result, (says the author,) we see that the given quantities of silver and antimony are susceptible of combining with nearly the same quantity of sulphur. We know that the sulphuret of silver contains 2 atoms of sulphur and 1 atom of silver, and that the sulphuret of Antimony is composed of 3 atoms of sulphur and 1 of antimony. Consequently, the chemical constitution of the antimoniated sulphuret of silver will be expressed by $2SbS^2 + 3AgS^2$ and the calculated results will become—

Silver	58.98
Antimony	23.46
Sulphur	17.56

100.

The mineral examined, was the Red Silver of Andreasberg.
Ann. de Chem. Jan. 1822.

2. *Solubility of Magnesia.*—Very different degrees of solubility have been assigned by different chemists, both to pure magnesia and to the carbonate, in hot and in cold water.

According to Dr. Henry, water dissolves—

$\frac{1}{33000}$ of magnesia.

According to Kirwan, $\frac{1}{70000}$

According to Dalton, $\frac{1}{100000}$

Dr. Thomson states it to be entirely insoluble.

The same uncertainty prevails with respect to the carbonate.

Dr. Murray states that water takes up $\frac{1}{33000}$, and Mr. Brande, that this salt is perfectly insoluble.

Dr. Fife of Edinburgh has recently examined this subject, and finds that water at 60° dissolves $\frac{1}{37000}$ of its weight of magnesia, and that at the boiling temperature it takes up only $\frac{1}{300000}$. Magnesia then, like lime, has the property of being much less soluble in hot than in cold water.

It is the same with the carbonate.

Water at 60° dissolves $\frac{1}{33000}$
 at 212° $\frac{1}{50000}$

To prove the greater solubility in cold than hot water, it is only necessary to heat, gradually, a transparent cold solution in a glass with a long narrow neck to prevent too great evaporation. At the instant of ebullition a flocculent matter is precipitated.
Ed. Phil. Journal.

3. *Heat.*—The power of different substances to conduct heat, by transmitting it from particle to particle internally, has been newly examined by M. Despretz. He finds the conducting power of copper to be greater than that of iron, in the proportion of 12 to 5. Zinc and tin do not differ much from iron. The conducting power of lead is less than half that of iron, and five times less than that of copper. Mar-

ble conducts twice as well as porcelain, but the conducting power of marble is nevertheless but $\frac{1}{18}$ part of that of iron. Brick has much the same power as porcelain, namely, half that of marble. *An. de Chem. Jan. 1822.*

4. *Means of preserving eggs.*—M. Cadet of Paris, relates that on the 24th of November, 1820, he put half a dozen fresh eggs into a glass jar, and filled up the jar with lime water, containing an excess of lime. On the 8th of September, 1821, the Council of Safety charged Messrs. Marc and Pariset to examine the result of this trial. One of the eggs, which by accident was cracked without being broken, was found to be entirely coagulated, but did not emit the least unpleasant odour. The others were full and had preserved entirely their transparency. When boiled during three minutes, they appeared very delicate and of an excellent taste. *Idem.*

5. *Steam Boats* are employed at Stockholm (Sweden) for the purpose of towing ships into and out of port, when contrary winds prevail;—and this process is found to be much preferable to the method before used, in regard both to expense and celerity.

6. *Mechanics.*—The Emperor of Germany, convinced of the advantages which will result from a more profound knowledge of the theory and proper construction of water mills has lately offered a thousand golden ducats (about \$2000) to the author, whether a native or a foreigner, who, in the course of a year, shall furnish the best work on that subject. As it is designed for the use of workmen, great perspicuity will be requisite. *Rev. Ency.*

7. *GENEVA.*—*Society for the advancement of Arts.*—This society was founded in 1776, by the instrumentality of the celebrated Saussure. It has rendered very important services to the Cantons, and with a view to more extended usefulness, it has recently undergone some internal modification. It is now composed of three great divisions or classes, viz: that of the *fine arts*, that of the arts of industry, economy, and commerce, and that of agriculture. Any person who feels interested in the progress of the useful

arts, and wishes to contribute to their prosperity may become a member of either of the classes, simply by being proposed by two members, accepted by its committee, and paying the annual sum of forty florins, (\$3,75 cts.) By a further contribution of twenty florins, he may become a member of either of the other classes. The members of each class enjoy the privilege of attending all its deliberations, of communicating their researches, of asking for information, proposing questions on the subject of prizes, electing committees, and assisting in the general meeting of the Society.

8. GENEVA.—*Mutual Instruction*.—Notwithstanding its detractors, and the hostile insinuations which were recently advanced in the discussion relative to the best means of perfecting literary studies in Geneva, the plan of mutual instruction is making incessant progress. In the course of the last year, Lancasterian schools have been erected in the towns of Carouge and Versoix, and in the communes of Laney, Perly, Certour, Meinier and Cholen. The government, always ready to favour useful enterprizes, has liberally assisted these new institutions, whose beneficent influence it wishes to extend to all parts of the Canton. The large building newly constructed in the court of the college of Geneva, will contain 300 or 400 pupils. This large school is the third which has been instituted in the principal town in the Canton.—*Rev. Encyc.*

9. *Rural Economy*.—An experienced farmer of the Netherlands assures us that an ounce of saltpetre dissolved in a pint of water with an ounce of flour of sulphur, and scattered upon grain in a granary, is an infallible means of preventing it from spoiling.—*Idem.*

10. *Agriculture, Liege, Netherlands*.—One of the prize questions proposed by the "Society of Encouragement and Emulation," of that city, and decided at its public session last year, was, *Is it better to mow the first crop of grass in the season while it is still tender—or not until it has acquired full maturity and produced seed?* The prize was divided between C. J. Van Hoosebeke and H. P. Tilleman. They both decide, in their memoirs, that it is better to mow at

the time of inflorescence, because the plants are at that time more replete with nutritious juices. *Idem.*

11. **BRUSSELS.**—*Encouragement to Science.*—Count Sack, who has published a voyage to Surinam in two volumes 4to, remarkable for the luxury of its typography, has received lately from the king, as a reward for the service he has rendered to science, a rich gold medal, very tastefully wrought. On one side is the portrait of the king, and on the reverse, this inscription :—*A Sackio, libero baroni, pro oblato munere litterario, rex, 1819.* M. de Sack proposes to make another voyage to America, and add new riches to those he has collected in that part of the world. An English translation of his first volume has already appeared.

Idem.

12. **Amsterdam.**—A society has for some time existed in this city for the amelioration of the instruction and civilization of the Israelites of the lower class. It is composed of persons of every sect, whose philanthropic efforts have already produced happy results.

13. **The Royal Academy of Paintings at Amsterdam,** has just been inaugurated in its new locality. The building is divided so as to accommodate 400 pupils. Already it has become impossible to admit all that have presented ; the number of whom exceeds 1200, which is certainly very considerable, since there exist in this city other establishments which have the same end, and which owe their origin as well to the care of the municipal authority as to that zeal for the arts which animates so many of the inhabitants.

Idem.

14. **Bordeaux.**—Steam-boats meet with full success in this city. Four of them go daily from Bordeaux to Langon, and ascend the river as high as the tide will admit. Two of them make the passage as far as Pauillac on the Gironde, and even in the season of sea bathing, to Royan. Another steam-boat constructed at Bordeaux has been sent to Havre, where it is employed in crossing to and from Honfleur. An eighth will soon issue from the same ship-yard,

which is to be sent to Martinique for the service of that Island. *Rev. Ency.*

15. *Astafort.—Mutual Instruction.*—Two children extremely addicted to stuttering, were admitted to the Lancasterian school of this town. The frequent repetition of the exercises in a loud voice, and the assiduous care of the master, completely succeeded in curing them of this distressing habit which was the more difficult to remedy, as it was hereditary. *Idem.*

16. *Caen.*—A school of mutual instruction has been lately opened in the Central prison of Beaulieu, by the care of the director of that establishment. All the prisoners are willing to profit by the lesson, and their progress has been very satisfactory. The reading of religious and moral works has already had a remarkable influence upon them. No doubt remains that this result will be as happy here as it has been in other similar places, especially in the prison of Montaign at Paris, and in the *maison de detention* at Saint Dennis. *Idem.*

17. *PARIS* —*The Linnean Society of this city* held on the 28th December, 1821, its first public annual session since its reorganization, under the presidency of M. de Lacépède. This day was chosen from its being the anniversary of the death of the illustrious Tournesort, who opened the way for Linneus and his disciples.

In the opening discourse, M. de Lacépède shewed the extent and importance of the labours of the Society, and felicitated himself on his having been one of its first founders in 1788, and on the happiness of surviving so many distinguished men who had been cut down by the fury of faction, to preside on this day at the reorganization of a society, destined to reestablish and to propagate the sound doctrines dictated by Linneus, and to finish the edifice erected to the genius of the Swede by the gratitude and admiration of French naturalists. This discourse was received with great applause.

M. Thiebaut de Berneaud, perpetual secretary, gave an account of the labours of his learned brethren. He first took a rapid view of the early period of the Linnean Socie-

ty, of the persecutions it had experienced, and of the melancholy end of its most zealous founders. He stated the efforts which had been made in 1797, to re-establish this firm institution ; and he gave a succinct analysis of the memoirs read at his private sessions. They are numerous, and extend to all the branches of natural history. This statement of the secretary and the memoirs to which it alludes, will appear in the first volume of the Acts of the Linnean Society. The eulogium on Tournefort was pronounced by M. Lefebure, one of the vice presidents, in which he forcibly recapitulated the services rendered by this philosopher, to the most attractive of the sciences. A discourse was pronounced by Dumont d'Unville, a skillful mariner and profound naturalist, on the Volcanic isles of Santorin. In the neighbourhood of Yuctot, department of the *Seine inferieure*, there is an oak remarkable for its antiquity, and for the existence of a chapel in the cavity of its shell. This chapel has been known one hundred and twenty-five years ; it is attended by a priest, who has his habitation in the upper part of the trunk. The top of the tree was broken off more than fifty years ago, and has been replaced by a steeple. The branches of this tree are covered every year with foliage.

The Society offer a gold medal of the value of 300 francs, to the author of the best memoir on the movements and condition of the sap in all the phases of vegetable life, and in the different seasons of the year. The results must be drawn from reiterated experiments and new considerations.

Idem.

18. *A Religious Tract Society* has been established in Paris for the purpose of spreading either gratis or at a very low price, small tracts, which shall present under various forms the most important truths and the finest lessons of christianity as it is contained in the gospel.

19. *Conservatory of Arts and Trades at Paris.*—A new amphitheatre has been erected at this noble Institution, for the purpose of accommodating those who shall attend the lectures on the application of science to the arts. It is universally approved for its elegant form, its distributions and, the ingenious manner in which it is carved. The Session

was opened on the 8th of January last by Charles Dupin, in quality of professor of mechanics applied to the arts. He was followed by Clement Desormes, professor of chemistry, and lastly by J. B. Say, professor of economy of industry, (*économie industrielle*.)

20. *Mineralogy*.—F. S. Beudant is about to publish at Paris his mineralogical and geological tour in Hungary, in the year 1818. The price of the three volumes with the atlas, is seventy francs.

21. *The Himalaya chain of mountains*.—A report was made to the Asiatic Society of Calcutta, on the 17th of Feb. 1821, by Capt. Hodgson and Lieut. Herbert, relative to the trigonometric measurement of the mountains of the central chain of Himalaya. This important memoir contains, 1st, a physical description of those countries, and of the instruments employed in the operation. 2d, latitudes of the five principal stations, deduced from a series of 122 observations of the height of the sun or stars. 3d, longitude of one of the stations, viz. place of departure, deduced from the latitude of Jupiter. 4th, the determination of a base of 27,000 feet. 5th, the chain of triangles to the number of 121. 6th, a table of heights above the level of the sea of thirty-eight summits or peaks of the mountainous chain, covered with snow. The greatest height is 25,589 feet, (= five miles nearly,) lowest height 16,043 feet. The Himalaya has more than twenty summits higher than Chimborazo.

22. *Tribe of Scotacks*.—Few geographers or translators have spoken of the *Scotacks*, a people of Hungary, remarkable with respect both to their number, and their manners. They are of Slavonian origin, and form a race between the Slavons, the Vasmiaks, and the Poles; but they differ totally from those nations by their dialect, character and customs. According to some travellers, they have, almost all of them, men and women, white hair, it being very rare to find any one with dark locks. They live in patriarchal style, and assist each other as parts of the same family; the father confides the oversight of his house to the son whom he thinks best qualified for the trust, and the others respect

and obey his orders, whatever may be his age. They are a pastoral people; they purchase every year in Transylvania and Moldavia, flocks of sheep which they fatten in the summer, and sell them afterward in the market of Hannasalva, or in Bohemia, Moravia, and Silesia. Many of them are waggoners, and transport wine and leather to Poland, Russia, Prussia, and Austria. The Scotacks never make war against the other tribes, on which account they have preserved their dialect free from the mixture of foreign idioms.—*Rev. En. Feb. 1822.*

33. *Geneva.*—A young lady born blind, but distinguished by her talents and amiable disposition, imagined that if some mechanic would invent a printing press adapted to the use of the blind, she could communicate her thoughts by that means to her distant friends. She imparted this idea to Francis Huber, the celebrated writer on Bees, who as it is well known, is also blind. Immediately by the help of his domestic, Claude Lechet, a man endowed with uncommon mechanical talents, Huber invented and constructed a press, which he sent to the young lady, with an assortment of types. After a very short apprenticeship, she was able to enjoy in perfection this precious method of communicating her thoughts. We have seen a letter of thirty-three lines addressed to her benefactor, composed and printed by herself, with common ink, without any fault or typographical irregularity.—*Idem.*

24. *The German Language* appears to be making rapid progress in Italy, and especially in Lombardy. Gratuitous professorships are every where erected. At the Lyceum of Milan, more than 200 pupils frequent the German course, and nearly 300 learn the language in other schools. The number of persons who are enabled to read the best German works, amounts, it is said, in that city, to 5000.

25. *Rome.*—The celebrated Abbe Mai, has discovered, it is said, some classic manuscripts which he thinks will probably prove as interesting as the treatise of Cicero *De Republica*. He hopes soon to publish a part of them.

26. *Lithography*.—M. Montin has discovered near the town of Cervesa, in Spain, a quarry of stone fit for Lithography. From experiments made at Madrid, in the lithographic press of de Brussi, its quality appears excellent. This discovery will be extremely advantageous to Spain, and even to the south of France.

27. *Maestricht*.—A school of mutual instruction has been some time established here, of which 250 of the pupils did not know even the alphabet, on their admission.—Nine months are found sufficient to enable them to read; but, what is more, in another nine months they become acquainted with the *French* as well as the *Dutch Language*, by reciting the lessons alternately in both. Their progress in writing is not less rapid, and in 18 months they learn to calculate. Many among them that had been for years in other schools without learning to count beyond a hundred, have acquired such a habit of calculating and reasoning, that the most difficult problems do not discourage them. Next year we shall learn how much time will be requisite for the study of the grammar of the two languages. The principles of linear drawing are to be taught to those in the 8th writing class. The success of this school shows that simultaneous instruction in the two languages, is perfectly adapted to *border schools*.

28. *Besançon—France*.—The Academy of Science and Belles-letters of this town, offers a gold medal for the best essay on the question—*To what extent has the principle of honour contributed to the splendor and true glory of the French Monarchy?*

29. *New Astral Lamp*.—M. Georget, lampist, Rue St. Honoré, No. 2, Paris, makes new lamps, of which the reservoir of oil is placed *above* the light, so that it furnishes a constant level by a uniform conductor. The *crown*, thus becoming useless, is suppressed; whence it results that the shadow produced by the horizontal circle cannot take place. These lamps have the further advantage of being easily transported, without the least danger of spilling the oil.

30. *A Carpet* has been manufactured at the Royal establishment of the *Savonnerie* at Paris, destined for the Hall of the throne, which is believed to be the largest that has ever been executed. It is 50 feet long, and 30 wide, and might have been done in one piece agreeably to the design, but it would have required in that case, 9 years for its execution. For the sake of greater expedition it was divided into three parts which have been accomplished in three years. Agreeably to the details that have been furnished, it has cost in labour alone 50,000 francs, (\$10,000.)

31. *Iodine as a Medicine.* We have already stated the beneficial results which M. Coindet had obtained in employing Iodine in the treatment of Goitre; but then this curious substance was administered internally, and we have had occasion to remark that in some cases, unpleasant symptoms were produced by the local action of the Iodine upon the mucous membranes of the stomach. The same physician has since tried to introduce this substance into the animal economy by simple friction, and he announces a success equal to the former. Twenty-two patients of different ages and sexes, have been treated by this new process. They had all very large goitres; more than one half of them were completely cured in the space of from four to six weeks, and the others in a greater or less degree. The ointment which Dr. Coindet employs, is composed of half a gros of hydriodate of potash with $1\frac{1}{2}$ oz. of hogs lard. The part is rubbed morning and evening with a portion of ointment as large as a nut, until the whole is absorbed.

Dr. Coindet states that he has used Iodine in the treatment of scropula, "with a success which surpassed his hopes."—*An. de Chim.*

32. *The Muriate of Copper and Nitrat of Soda of Peru*—From a statement made by M. Mariano de Rivero, a Peruvian, it appears that the muriate of copper, so much admired for its fine colour, is found in large quantities in the district of Tarapaca, in the gold and silver mines. It accompanies the ore called *Yabicoia*, and is found in veins, in such quantity, as to give rise sometimes to extensive workings. The Indians of Atacama extract it, grind and sift it, and sell it in the state in which we see it. They call it

Arenilla. It is used in all Peru and especially in the province of Arequipa and in Chili as sand in letter writing. The muriate in these grains is mixed with quartz which is its gangue.

The nitrate of soda in the district of Atacama is found in beds of variable thickness, extending more than fifty leagues, covered with clay. The quantity is so great that more than 40,000 quintals have already been obtained, and the proprietor will engage any portion that may be desired. The salt in some places is extremely pure; in others it is mixed with clay, which is easily separated by solution and crystallization.

33. Galvanic Instruments.—Electro Magnetism.—The beautiful discovery of Oersted of the magnetic power of the galvanic battery, has excited the zeal of philosophic experimenters almost every where. A magnificent apparatus was constructed last year at the Imperial Museum of Florence, under the direction of Count Girolamo de Bardi, director of that establishment; and the experiments with it were performed by himself, assisted by M. Gazerri, professor of chemistry in the hospital of S. Maria Nuova of that city, and Car. Antinori, professor of a philosophical cabinet, together with Prof. Pictet, and Dr. Marcet, of Geneva, who were then in Florence.

This machine consisted of six plates of zinc each, with a double surface of copper, and containing in the whole 41016 square inches of active surface. The plates of copper were put together so as to form cells or troughs, in each of which a zinc plate was immersed and kept insulated from the copper by being previously put into a linen bag. Brass conductors establish the communication between the zinc of each trough and the copper of the adjoining one. Any of these conductors could be instantly removed or replaced, by which means the voltaic current could be stopped, or the whole or any part of it be brought into immediate activity. With a long funnel of six orifices, the whole of the troughs could be filled at once. The troughs were well compacted in a wooden frame and mounted on small wheels. The calorific power of this machine was such as to ignite fourteen inches of platina wire one third of a line in diameter, in a few seconds. A steel wire of twice

the diameter was melted in five seconds. A careful estimate of the calorific power of this instrument, was made by Prof. Pictet, in successive intervals of one minute each, by immersing the conducting wire in a silver cup which weighed fifty-nine grains, containing seventy-two grains of water, into which a thermometer was plunged with a very small bulb. The bulb rested on the conducting wire in the bottom of the cup. When the conducting wire was about eight inches long, the thermometer rose in one minute from 43° to $82\frac{1}{2}^{\circ}$ Fahrenheit, and in one instance, with a very short wire, from 43° to 111° Fahrenheit, in the same time. With a short platina wire as a conductor, the water soon acquired the boiling temperature ; and what was well worthy of remark, the ebullition ceased *instantly* on the interruption of the circuit, and *instantly* re-commenced on its renewal, without any appreciable time between the cause and effect. This fact appears to prove that the progress of heat in the galvanic battery, from its connection with electricity, is, like the latter, altogether inappreciable, *notwithstanding that it moves this solid matter.*

When the conjunction between the poles was formed by two platina wires, of different diameters, placed parallel to each other, the larger wire was always ignited, but the smaller one never. When the same two wires, attached end to end, formed the connection, the smaller wire was always ignited, when attached to either of the poles.

A sewing needle, placed at right angles to the conjunctive wire and above it, acquired magnetism in three seconds.

When the conjunctive wire was placed exactly in the direction of the magnetic meridian, a magnetised needle, freely suspended under it, declined 72° from the N. to the W.

Two conjunctive wires were placed very near each other, but without touching ; they then cut each other at right angles, in a horizontal place. A magnetic needle was then brought under them, and its north pole stood between the south and east, and when placed above them, the same pole stood between the north and west. The conjunctive wire was twisted into a spiral form and placed with its axis in the magnetic meridian. The needle being placed under the spiral, its north pole deviated 70° from N. to W. and when

placed above the same spiral, the needle took the opposite direction.

A platina wire which formed part of the voltaic circuit, strongly attracted iron filings, (as Mr. Arago had observed with respect to copper.) A tin wire did the same, but melted almost instantly.

The following experiment was made with the common electric machine :—

A needle was placed within an iron spiral, and the Leyden bottle was discharged through the latter. The needle was magnetized but not the spiral. This was repeated many times with the same results.

M. A. Van Beck, of the Philosophical Society of Utrecht in Holland, also states the results of an experiment with a single combination of copper and zinc. The zinc plate was 3600 centimetres, (about 1440 inches,) square, and the plates of copper were, as in the Florence machine, formed into a trough which contained the fluid, consisting of sixty parts water, one part sulphuric acid, and one part nitric.

The galvanic current being disposed in a direction parallel to the magnetic meridian, caused a needle eight inches long to decline 70° to the E. and to the W. according as it was placed above or below the conductor ; whilst with a very small and susceptible needle, the galvanic current seemed to prevail entirely over the terrestrial magnetism, in giving it a declination of 90° .

The conjunctive wire, in this instrument, also attracted iron filings very forcibly. The filings remained attached to it as long as the poles were united, but fell off immediately on the cessation of the current.

A small bar of steel was perfectly magnetised, by M. Van Beck, in five minutes, by placing it in a tube of glass surrounded spirally by a brass wire which formed the connection. The north pole is formed on the negative side when the spiral is wound from the right, and on the positive, when it is wound from the left. He also proved that steel may be magnetised in the same manner with great facility by the common electric machine, by a discharge of the battery through the brass spiral, or even that of a Leyden bot-

tle. Indeed when the current is drawn through the spiral by taking sparks from the conductor, the steel becomes evidently magnetized.* *Bibliothèque Universelle.*

34. *Electro-Magnetism*.—Professor C. W. Böckman, of Carlsruhe Baden, in a memoir addressed to Prof. Pictet, states that he has repeated the experiments of the Chev. Yelin, of Bavaria, relative to the magnetism produced by common electricity, and finds that when steel needles are either enclosed in a glass tube or enveloped in waxed cloth, silk, wood, ivory, or paper, and a wire turned spirally round the envelope, the steel is always magnetised when a Leyden bottle is discharged, or when strong sparks are passed through the spiral wire. He has demonstrated that the magnetic force increases with the electric tension or number of discharges to a certain extent, when it acquires a maximum.

It seldom went beyond fifteen or twenty discharges, with common electric bottles. The magnetism appears also to be increased by increasing the number of turns in the spiral wire.

* After the paper, "On the magnetic effects produced by Dr. Hare's Calorimeter," was printed, Professor Silliman received the notice in the text. I was entirely ignorant of the experiments of Mr. Van Beck, when mine were undertaken, and all the information I now possess on the subject is derived from the above notice. There seems, however, to have been a difference in the results obtained by Mr. Van Beck and myself; that gentleman found that the end of the needle which was connected with the zinc plates of his battery, acquired *north* polarity when the turns of the spiral of brass wire about the glass tube passed from *left to right*—and *south* polarity, when they passed from *right to left*. The results obtained by me were directly the reverse of these; and in my experiments, (which have been often repeated in the presence of Professor Silliman,) the end of the needle connected with the zinc plates, *always* acquired *south* polarity when the turns of the spiral passed from *left to right*, and *north* polarity when they passed from *right to left*.—I will now add the result of an experiment which has been performed since the publication of my paper. A brass wire was wound about a glass tube from *left to right*, until half of the tube was covered by the wire, when the direction of the spiral was changed, and the wire wound about the remaining half of the tube from *right to left*. A needle, free from magnetism, having been enclosed within the tube, the ends of the spiral were connected with the opposite poles, and the plates immersed, and again raised from the fluid. On removing the needle, its two ends were found to have acquired *north* polarity, while the middle had acquired *south* polarity. This experiment was often repeated, and the same results obtained.

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He found that magnetism was produced in a needle, fixed in the axis of a glass cylinder or bottle of eight inches, and even of thirteen inches in diameter, surrounded by a spiral. He contrived to turn a metallic wire into a spiral of seven feet in diameter, and found that needles placed in the axis were slightly magnetised by strong discharges through the spiral. *Idem.*

Prof. Erman, of Berlin, has shown the connection between magnetism and voltaic electricity, in the following ingenious way. In a silver or copper crucible he places a watch glass, and in the glass a small mass of zinc. A strip of zinc or of tin is fastened at one end to the mass of zinc, and extending upwards and outwards over a pasteboard band in which the cup rests, it is fastened at the other to the cup itself. This forms a complete voltaic circuit, and the current is established as soon as the cup is filled with acidulated water. When the apparatus is suspended to a thread, and a magnetic bar is brought near it, either an attraction or a repulsion takes place, according to the direction of the galvanic current in the apparatus and the magnetic current in the bar. *Bib. Univ.*

35. *Estimation of the mass of water which flows down the Rhine, at Bâle.*—The determination of this curious problem has been undertaken with much address by M. Escher, of Linth. The rise and fall of the water is ascertained with sufficient precision by a *Rhonometre*. A section of the bed of this river was obtained by measurement, and the mean velocity of the water carefully determined. The result is that the medium quantity of water which flowed down the Rhine in one year, is 1,046,763,676 cubic toises of 1000 feet each.

To form an idea of this volume, the author supposes for a moment a basin of fifteen leagues in length and five in breadth; for example, the lake of Constance. He found that the flow of the Rhine in 1809, poured into that basin, would raise it to the depth of fifty-six feet. If then the lake of Constance were empty, it would require many years for the Rhine at Basle to fill it, for the mean depth of that lake, in all probability, greatly surpasses fifty-six feet.

It would be interesting to the readers of this journal to be able to compare with the above result, the cubic amount of water which flows annually down the precipice of Niagara, by actual measurements of the river at some convenient place above the falls, and accurate calculations founded upon them. An estimate might be formed of the whole mass of Lake Erie; and admitting that it received no supplies, the time requisite to disembogue itself at the present rate of discharge over the falls might thus be approximated.

36. *Hospital of Mount St. Bernard*.—It appears in a "Notice or memoir upon the natural history of St. Bernard," by the Pere Biselx, prior of the convent, that from thirty to thirty-five thousand rations of food are annually distributed to travellers of all conditions. The cold and exposed situations which the benevolent inmates of that great hospital voluntarily inhabit, subjects them to acute and incurable rheumatisms, and obliges them when still young to descend to the plains, and drag out a life of pain and distress. This evil is found to be susceptible of remedy by such alterations of the edifice as modern science is competent to effect; but their funds are exhausted in the relief they extend to the pressing wants of travellers. To enable them to accomplish those improvements so essential to their own comfort, a subscription has been proposed, and *De Candolle* and *Turretini*, bankers of Geneva, have agreed to become the depositaries of whatever may be offered for that purpose. Their correspondents in London are P. L. Le Cointe & Co. and in Paris, Vassal & Co. Professor Pictet and De Candolle, of Geneva, are associated with the bankers in the disposal of the funds. *Bib. Univ.*

37. *Extensive Draining*.—The Prince De B. a very rich landed proprietor in the government of Koursk in Russia, had on his estate a marsh or swamp of 7800 acres, which in the spring of the year became a lake, and produced absolutely nothing but reeds and rushes. In its driest state neither man nor beast could cross it without hazard.

In the course of his journies in other parts of Europe, especially in England, the prince became satisfied that his lands might be rendered much more productive. An Eng-

lishman, on learning the situation of this marsh, undertook to drain it; and in the course of a year from its commencement, the work was completed, and this vast tract which was only a reservoir of unwholesome miasmata was converted into a fertile soil, adapted to the various agricultural productions. This prince having tried all the pleasures which fortune and high rank can yield in the luxuries of a court, has retired to his estates, and finds in a devotion to objects of utility and to the amelioration of his people, the secret of being truly happy. *Idem.*

38. *Galvano-magnetic-condenser*.—A delicate instrument for exhibiting the magnitiferous property of a weak galvanic combination, has been invented by M. Poggendorf of Berlin. It is simply a wire rolled in the form of a spiral so as to make thirty or forty turns. The wire is covered with silk in the same manner as the large cords of a harpsichord are with fine wire. The spiral is placed vertically, and a steel needle, not magnetic, is suspended horizontally within it, on a vertical pivot. Thus arranged, if one end of the spiral be brought into contact with a zinc plate, and the other end with a copper plate, and the zinc and copper be each connected with a humid substance, or water acidulated with nitric acid,—the needle soon acquires polarity, and arranges itself in the magnetic meridian. M. Oersted considers a needle thus mounted as a *galvanoscope* much more sensible than a prepared frog. *Ed. Phil. Jour.*

39. *A soft crystal of quartz*.—In a memoir on the marble of Carara in Italy, by Ein. Repetti, the following singular fact is mentioned by the author.

In the spring of 1819 Mr. del Nero proprietor of one of the quarries in the Vossa del l'Angelo, in sawing out a large block destined for a column in the temple of St. Francois at Naples, discovered in the interior of the marble, what the workmen term a *lucica*, viz. a crystal of calcareous spar of considerable size. In digging this out they found a cavity in the marble lined with crystals of quartz, and containing about a pound and a half of liquid perfectly transparent and slightly sapid. They observed with surprise in this cavity a protuberance as large as a finger, transparent and which appeared to have all the characters of a rock crystal of that

size. M. del Nero, delighted to find himself in possession of one of the finest crystals of hyaline quartz, which the country had produced, proceeded to disengage it at the base; but to his inexpressible surprise, he found it elastic and of a pasty consistence, taking any form his hand gave it, but rapidly growing harder, and soon becoming quite solid, and assuming the appearance of calcedony or porcelain. In a moment of vexation he threw it among the rubbish, and thus lost a specimen which would have been highly interesting to the curious.

He assured me, (and his assertion was repeated by other witnesses worthy of confidence) that facts of the same nature had occurred to them more than once. I made him promise that if another such instance should present, he would impress his seal upon the crystal and send it to me at Florence, with the water which the cavity might contain. Professor Pictet remarked that he saw at Florence in the collection of Dr. Targimi, a rock crystal containing several drops of petroleum in small cavities without communication with each other or with the air. One of them was opened to satisfy Sir H. Davy, when at Florence, of the nature of its liquid contents.

Bib. Univ.

40. *A simple but interesting galvanic instrument* is described by Professor De la Rive of Geneva in the *Bib. Univ.* of December last. A strip of zinc about the sixth of an inch wide, and another of copper are passed through a small cork float, so that the copper shall bend round the end of the zinc and in some measure enclose it. To the upper part of each strip, the extremities of a copper wire, previously covered with silk and rolled into the form of a ring by seven or eight turns upon itself, are to be soldered. The ring should be an inch or an inch and a half in diameter. When this float is placed in a vessel containing acidulated water, the galvanic current is established. If a magnetic bar be then presented to the ring, so that the currents proceed in the same direction, the ring will be attracted and will pass over the bar; but if the other pole be presented the ring will be repelled; but at the same time it will seek to take another position by turning half round and will then return to the bar and pass over it.

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If this ring have a diameter of three or four inches, and the instrument be not too heavy, it possesses the power of self direction, always arranging itself in a plane perpendicular to the magnetic meridian.

Bib. Univ.

41. *Two other ingenious and simple instruments for shewing the effect of Electro-magnetism*, are described in the recent journals. One* of these, by P. Barlow, Esq. of the Royal Military Academy, is as follows:—

“A B (see the plate at the end) is a rectangular piece of hard wood; C D E a stout piece of brass or copper wire and *a b c d*, a rectangle of smaller copper coin, (soldered at E) on the lower side of which the wheel W of thin copper turns freely: *f g* is a small reservoir of mercury sunk in the wood; *t g i* a narrow channel running into it. H M is a strong horse shoe magnet.

“Mercury being now poured into the reservoir *f g* till the teeth of the wheel are slightly immersed in it, and the surface covered with weak diluted nitric acid, make the connection with the battery at *i* and D: and the wheel W will immediately begin to rotate with an astonishing velocity, far beyond the power of the eye to follow, and will thus produce the most pleasing effect.”

“The galvanic apparatus which I employed to produce this motion was the Calorimotor of Dr. Hare which I had made of the plates of my old battery, 20 of zinc and 20 of copper, each ten inches square. But a much less powerful combination will be sufficient.”

The suspension of the wheel is shewn in figure 2, and it may be proper to add, that in order to ensure a complete contact, the two sockets, or the end of the spindle, should be amalgamated, as also the tops of the points of the wheel.

“If the contact be changed, or if the magnet be reversed, the motion of the wheel will be reversed also: but I find the best effect produced when the wheel turns inward.

42. *An Iron Steam Boat* has recently made a voyage from London to Rouen in 55 hours, and then proceeded to Paris. This is doubtless the first attempt to traverse the ocean in a vessel composed of any material but wood.

* For the other, see Phil. Mag. for June, pa. 434.

The Tyne Mercury mentions a new iron boat having been launched at New Castle, thirty one feet in length, which draws only two inches of water. *Til. Mag.*

43. *Canal Steam Navigation.*—With a view to the introduction of steam vessels on canals, a very interesting experiment was made in the Union Canal at Edinburgh, on June 22, at 2 o'clock, with a large boat twenty-eight feet long, constructed with an *internal* movement upon the principle of a model invented by Mr. Wight, and exhibited to a general meeting of the Highland Society of Scotland in the month of January last. A committee appointed for the purpose by the Directors of the Highland Society attended to witness the experiment, and the chairman and most of the members of the Union Canal company were also present. The boat had twenty-six persons on board; and although drawing fifteen inches of water, she was propelled by men at the rate of between four and five miles an hour, while the agitation of the water, being confined entirely to the centre of the canal, was observed to subside long before it reached the banks, and consequently obviating its hitherto destructive tendency in washing them into the canal.

Star.

* * * * *

44. *Mr. Brongniart's Notice of American Specimens of Organized Remains.*—A letter from Mr. Alexander Brongniart to the Editor, dated May 23d, 1822, expresses great interest in, and gratification from, the various specimens of American organized remains which he had received, especially from those forwarded through the Editor, from Mr. E. Hitchcock of Massachusetts, Mr. E. Granger of Zanesville Ohio, Mr. Z. Cist of Wilkesbarre, and Mr. G. T. Bowen of Providence. Should the friends of Geology continue (which it is earnestly hoped they will,) to furnish similar specimens to Mr. Brongniart he will soon be in a condition to draw those general conclusions respecting the American formations by means of which they can be successfully compared with those of the Eastern Continent.

45. *Professor Berzelius.*—A letter has been received by the Editor from Professor Berzelius of Stockholm, dated April 22d, 1822, accompanied by a collection of Swedish minerals. Among them is the chondrodite, which Professor

Berzelius remarks, "is the same as the American Brucite." Indeed it obviously agrees in its characters with the mineral whose analysis by Mr. Seybert is published in this Number. The Pyroxene Sahlite transmitted by Mr. Berzelius is identical with that found near New-Haven, and whose analysis by Mr. Bowen is found at p. 344.

46. *New Edition of Parkes' Chemical Catechism.*—Mr. Parkes has published the 10th Edition of his catechism and an 8vo Edition of the Chemical Essays, is going through the press, as we learn by a letter from the author. *Edit.*

II. DOMESTIC.

1. *Natural Ice House near Williamstown.*—Extract of a letter from Professor Dewey, dated August 16, 1822. In No. 10 of the American Journal of Science and Arts, pages 331, 332, is a notice of the Natural Ice House near Williams College. The reference to my name makes it necessary for me to request the insertion of the following additional remarks. This *Snow Hole*, as it is commonly called, is about a mile northwest of the north-west corner of Massachusetts. As the southwest boundary of Vermont is west of this corner of Massachusetts, the Snow Hole is believed to be in the town of Pownal, Vermont, and very near the line which divides it from the state of New-York. The lat. and long. are a few minutes greater than those given by Mr. Dearborn. In No. 4 of this Journal I had already given an account of this Natural Ice House. The dimensions of the chasm are rather greater than those assigned by Mr. Ives. I visited this Snow Hole a few days since, and found, on *accurate* measurment, that both the length and depth were a little greater than those I had already given, the width being correct. The form of the chasm is entirely irregular.

Very little ice or snow was to be found in the Snow Hole. The trees have been wantonly cut down to such an extent within some years past, that the snow is entirely melted, about the first of August. There are several chasms near this principal one. A few rods farther north is one of nearly equal dimensions, and more fully protected by the ledge

of rocks on its southern side. In this was abundance of ice and snow, some of which will probably remain through the year. The hand of man will probably destroy these natural depositories of snow, and, in a few years they will doubtless be known only as the places in which snow used to be preserved through the year.

2. *Prismatic Mica*.—Professor Dewey.—This mineral is found in Hinsdale in this county. It is on the edges of common mica like that of Saratoga. Only three or four very small fibres are often found on the edges of one of the lamina.

Mineralogical Notices, by Dr. TORREY.

3. *Green Zinc Ore of Ancram*, (Ancramite).—All the specimens of this mineral which I have seen, except one in the possession of Prof. Renwick, of Columbia College, have evidently undergone the action of fire, so that some have supposed it to be an artificial substance. The specimen of Prof. Renwick seems, however, to remove all doubts on this subject, as it has every appearance of a native mineral. Several excellent mineralogists who have seen it, have pronounced it so. This interesting ore has not yet been discovered *in situ*, although diligent search has been made for it since my account of it was published.

4. *Stilbite*.—A new locality of this mineral has lately been discovered by Gouverneur Kemble, Esq. in the highlands of New-York, opposite West-Point. It occurs in a decomposing cellular blueish feldspar, forming a vein in gneiss, in small aggregated crystals of a honey yellow colour. The crystals are four-sided prisms, with rectangular bases, about one eighth of an inch long, with several smaller and gradually diminishing cuneiform crystals applied to two opposite sides; giving the crystals a radiated appearance, with deep re-entering angles on the sides. The summits are truncated at the terminal edges, slightly bevelled in the direction of the laminæ of the crystal, which is also the case with the cuneiform additions. The faces produced by truncation and bevelment are brilliant, but the sides of the prism are often dull.

This mineral is easily cleaved in one direction, exhibiting brilliant folia, with a slight pearly lustre. It is hard enough to scratch glass feebly. By the heat of a candle it distinctly exfoliates, and before the blowpipe, intumesces considerably. It does not form a jelly with acids.*

5. *Siliceous Oxyd of Zinc*.—On examining a few weeks since, some specimens of minerals brought by Mr. Nuttall, from Franklin furnace in N. Jersey, I found among them the siliceous oxyd of zinc. It occurs in irregular masses, from an inch to three inches in diameter, disseminated in Franklinite. It is generally more or less mixed with the red oxyd of zinc. Its appearance when pure much resembles granular quartz. In fine powder it dissolves immediately in nitric acid, and the solution gelatinizes strongly. Since I examined this mineral, Dr. Langstaff informs me that he discovered it many years ago in the same place where it was found by Mr. Nuttall.

Mr. Geo. Boyd, a young and promising mineralogist, of this city, has just returned from a visit to Patterson and the neighbourhood of Sparta, and has brought with him a good collection of the minerals of these interesting localities, most of which are described in Mr. Nuttall's memoir. At the former place he examined the well where the Datholite is found. It occurs in large geodes in trap, about twenty feet below the surface of the earth. Some of the crystals which he found were an inch in length. But very small quantities of Datholite have yet been found except at this place.

6. *Franklinite*.—A fragment of this mineral, two inches in diameter, with four very perfect sides, was found by Mr. Boyd, near Franklin Furnace. He also found small crystals of the same mineral, exceedingly perfect, and with a lustre little inferior to that of spinell. They were octahedral, with the common base and lateral edges truncated. On examining these crystals, which were more perfect than those I received for Mr. Nuttall, I make the angle of the inclination of the pyramids 109° , which is almost exactly that of spinelle.

* I have been particular in describing this mineral, as the Stilbite has been recently divided into several species, and it is probable this constitutes one of them. J. T.

7. *Sulphuret of Molybdena, &c.*—This was found by Mr. Boyd, four and a half miles from Hamburg, N. J. imbedded in a mineral which is probably a variety of augite. It occurs in laminæ, sometimes more than an inch in diameter. In the same locality he found beautiful massive blue fluates of lime. He also brought with him several other rare minerals, but as they were found a short time before by Professors Keating and Vanuxem, who are preparing an account of them for publication, I think it would be improper in me to anticipate them.

8. *Zircon from N. Carolina.*—I have made an accurate goniometrical measurement of this mineral, and find the angles to agree very nearly with those given by Haüy. The faces of the prism form with the corresponding angles [faces? Ed.] of the prism, angles of $131^{\circ} 35'$. In the second edition of Cleaveland's mineralogy, they are said to measure about 135° . The angle of inclination of two faces of the pyramid $94^{\circ} 30'$.

9. *Summerville Copper-Mine.*—I lately visited the copper mines of Mr. Cammams, near Summerville, (New-Jersey.) They are situated in a trap or Greenstone mountain. The ore which is worked, is the red oxyd of copper. The following are the principal minerals yet found there :

Native copper, in irregular masses, weighing from one ounce to eight pounds. One specimen lately found weighed twenty three pounds.

Phosphate of Copper, massive, and of a verdigris colour. It generally accompanies the native copper. This mineral is not noticed by Cleaveland, as a N. American species

Carbonate of copper, green, and in connection with the phosphate.

Red oxyd of copper.—The massive variety is the common ore of the mines. It is also found crystallized in octahedra the surfaces of which are exceedingly brilliant. Many specimens found at the mines exceed in beauty any I have seen from Cornwall.

Native silver, in small masses disseminated through the phosphate and crystallized red oxyd of copper.

Green quartz, in tabular, partly noded masses. A beautiful mineral, resembling chrysoprase.

Prehnite, in cavities in the greenstone, very fine.

Mountain leather, in thin plates, very tenacious when moistened.

10. *Jeffersonite*.—Professors Vanuxem and Keating have published in the Journal of the Academy of Natural Science in Philadelphia, an account of a mineral discovered in Sparta, N. Jersey, to which they have given the name of *Jeffersonite*. It has a great resemblance to Pyroxene, (Augite,) but is conceived to present such differences as to justify arranging it as a new species. Its analysis gives—

Silex,	-	-	0.6125
Lime,	-	-	0.1463
Protoxide of Manganese,			0.1404
Protoxide of Iron,	-		0.1005

11. *Automalite*.—Professor Vanuxem has announced a new locality of this mineral at Franklin, N. Jersey.

12. *Notices of Mineral Localities*, by Mr. THOMAS H. WEBB, of Providence, R. I.

1. *Chlorite slate*, of a deep green and blackish brown colour, occurs in great quantities at Smithfield, about ten miles from Providence. It consists for the most of undulated layers, having more or less of a glistening surface, and a slaty fracture. Some parts of it have an earthy structure.

2. *Octahedral crystals of magnetic oxide of iron* are found imbedded in some parts of the abovementioned mineral, in great abundance.

3. *Ligniform asbestos* of a brown colour, with a greenish cast also occurs in the same vicinity.

4. There is likewise found here, a shining yellow sand, that appears to have been formed from fragments of decomposed mica.

5. *Titanium*, near the fluor rock, (in Sekonk,) in the crevices of some of the rocks, small irregular yellowish

crystals. The substance was analyzed by Dr. J. W. Webster, of Boston, and proves to be the "Prismatic Titanium ore of Mohs, the Sphene or Titane siliceo calcaire." He thinks there is also an oxide of Titanium in the rock.

6. *Cyanite*.—A specimen of it was brought in town a short time since, by the person who owns the place where it is found. He thought it contained silver or platina. Nothing however was known concerning its situation. In company with Mr. Amos Binney, jr. of Boston, I visited the place about three weeks ago. It is found on a Mr. Blanchard's land, in Foster, R. I. about twenty-one and a half miles south-west of Providence. It was first observed by him three years ago, while engaged in digging a water-course for a grist-mill. The specimens that we obtained had been weathered for some time. Some of the specimens were contained in quartz; other pieces appeared to be composed entirely, or in a great measure of Cyanite, held together by the intervention of small quantities of quartz. It occurs in long lamellar masses, and in masses that bear evident signs of irregular crystallization. Its colours are, a fine deep blue, a pale blue, and a pale green. Some pieces have a strong pearly white lustre, and are covered with beautiful blue stripes. There is a layer of black mica slate accompanying it.

It is an uncommonly beautiful mineral.—*Editor*.

13. *American Geological Society.*

The Cabinet of this Institution continues to receive valuable additions. A second collection of European rocks has been received from its President, William Maclure, Esq. and this gentleman, in addition to the books formerly mentioned, (Vol. III. pa. 360,) has recently forwarded to the Society's Library eleven Vols. of the *Revue Encyclopedique*, from its commencement in January, 1818, to September, 1821; also, Vols. 89—90—91 and 92 of the *Journal de Physique*, with the four last numbers of Vol. 37.

The volumes from 54 to 87 wanting to complete this Journal, will be forwarded as soon as they can be obtained. Valuable boxes of minerals, chiefly rock specimens, have been received from Professor Olmstead, of Chapel-Hill,

N. C.—from Dr. Allen, of Brattleborough, Dr. Porter, of Plainfield, Mass. and from James Pierce, Esq. of Catskill. The latter box illustrates the organized remains of the Catskill Mountains. Many of the impressions as well as of those which have been preserved in relief, are singularly distinct and delicate.

14. *Second edition of Cleaveland's Mineralogy.*

A review of this valuable work appeared in Vol. I. pa. 35 of this Journal. We have found no occasion to alter the favourable opinion there expressed; nor are the alterations in this edition sufficiently numerous to demand any new remarks.

One hundred and fifty-two pages of new matter, occupied chiefly by accounts of American localities have been added. "A few descriptions of new species and varieties have been introduced, and an appendix on meteoric stones." Some alterations—chiefly in arrangement, have been made, in consequence of the suggestions of friends in private communications, of reviews, &c. They are such as meet our approbation, and we doubt not that this excellent work will in its improved form, continue to receive, both at home and abroad, those decided marks of public favour, which were so liberally bestowed on the first edition.

15. *New Manuals of Chemistry.*

1. An Introduction to Chemistry, with practical questions, designed for beginners in the science, from the latest and most approved authors. to which is added a Dictionary of Terms: by John Ruggles Cotting, Lecturer on Experimental Philosophy.

2. A Grammar of Chemistry, on the plan of the Rev. David Blair, author of a Grammar of Natural and Experimental Philosophy, Universal Preceptor, &c. &c. adapted to the use of schools and private students, by familiar illustrations, and easy experiments, requiring cheap and simple instrumets; by Dr. J. L. Comstock, with numerous engravings on wood.

16. *New edition of a Grammar of Natural and Experimental Philosophy*; by Rev. David Blair.

An improved and enlarged edition of this work, under the direction of Dr. Comstock, has been published at Hartford.

17. *Formation of Calcareous Spar.*

It is not often that we can detect those causes actually at work by which natural mineral crystals are produced. It may therefore be interesting to mention the following circumstance :—Mr. Stephen Huggins, of New-Haven, on pouring out the contents of a bottle of Saratoga mineral water, which had stood several years in his cellar, found some well defined crystals and fragments of calcareous spar at the bottom of the bottle. They are now in my possession, and have the full lustre and the proper cleavage of Iceland spar, only their colour is a little yellow—owing, without doubt, to the carbonat of iron, which along with the carbonat of lime, forms a part of the contents of this powerful water, and is suspended in it by a high charge of carbonic acid to which the water owes its great briskness.—*Ed.*

18. *Catskill Lyceum.*—James Pierce, Esq. President of the Lyceum has recently read to that body two very interesting and instructive papers—the one on the various breeds and the economy of sheep, and the other on the nature and benefits of irrigation. Both papers are replete with interest, and do honour to the Lyceum of Catskill, which is not behind its sister Institutions in efforts to promote useful knowledge.

19. *Fluor Spar and Oxide of Titanium.*—Extract of a letter from the Rev. Edward Hitchcock, dated Conway, May 18th, 1822.

“I recently discovered the green fluat of lime in this town, in a vein of Mica slate, though in small quantities. It phosphoresced. If I mistake not, I have found also on crystallized quartz, not only the common eight sided geniculated prisms of the red oxide of Titanium, but also that mineral, under its primitive form, viz. a rectangular prism

with square bases—the sides of the crystal are not more than a fourth of an inch—and I found only two or three specimens. Tabular and radiated quartz occurs abundantly in this town, and most beautiful graphic granite.

20. *Bituminous Substances of Barbadoes.*—The editor has recently received from James R. Sample, Esq. of Barbadoes, specimens of the Barbadoes Tar, called in that Island Green Tar, and of the indurated Bitumen; there called Manjack. The green tar is petroleum of an excellent quality. Mr. Sample remarks that the Tar “is found very useful in preventing lockjaw, when the first symptoms are attended to, by rubbing the spinal bone from end to end, and the muscles of the thigh and arms; when taken internally it is also a powerful sudorific. Of the Manjack I have lately made an excellent pitch with tar and tallow, which makes wood impervious to water, and I have no doubt would also make a good varnish.”

21. *Oil stone of Lake Memphremagog.*---*Notice of two quarries of stone, lately discovered in Lake Memphremagog, Lower Canada.*—Communicated by Mr. Austin O. Hubbard of Stanstead, L. Canada.—The island on which the whitish stone is found, is one hundred rods long, and from sixty to seventy broad. The ledge from which the stone is taken, is situated at the southeast corner; and that part of the ledge which lies above the water, is about twelve rods in circumference. How far it extends into the lake, has never been ascertained. The island itself is about half a mile from the eastern shore of the lake, and seven miles west of Stanstead village. The quarry which contains the oil-stone, lies a few miles north of the island above mentioned, close to the eastern shore. It is wholly covered by the water, and is some times six inches, and at others, three feet below the surface.

Mills have been erected on the shore of the lake, and great quantities of these stones are annually prepared for exportation. The coarser stone is found to be good for common purposes, and the oil-stone is said to be equal, if not superior to that of Turkey. Indeed some idea may be formed of their excellence, from the fact, that since the discovery of the two quarries, (about two years) the profits of the proprietors have exceeded \$5000.

22. *Fluate of Lime and noble Agates in Deerfield, Mass.*

Dr. Cooley has discovered in Deerfield, purple fluat of lime, crystallized I believe in dodecahedrons--though I could not determine this certainly as I had no glass when I examined it. He also finds *noble agates* in a new locality in our Deerfield greenstone.

Letter from Rev. E. Hitchcock, March, 5, 1822.

23. *Useful Minerals in North Carolina.*—(Extract of a recent letter from Professor Olmstead.) I have recently performed a tour westward, almost to the blue ridge through the counties of Rockingham, Stokes, Surry and Guilford. The objects which among others were presented to us were the following.—An independent coal formation hitherto unobserved, embracing at least two beds of coal, fine varieties of Sandstone, numerous distinct strata of calp, and along with it a compact siliceous black carbonate of lime that receives a good polish, forming a handsome black marble.

It answers well to the description of the lucullite except that (owing probably to its containing a great portion of sillex ?) it is very fusible. We might suppose it basalt, but it effervesces freely. Westward of this secondary, I fell in with the narrow strip of transition laid down in Mr. Macclure's map. In this near Germantown, is a wonderful formation of lignite resting in numerous varieties of Potter's clay comprising the compact, heavy, chocolate coloured, used for stone ware, the adhesive which cuts like putty, and a bright yellow ochre. The extensive iron beds, the limestones, the ochres of Stokes and Surry furnished objects of much interest. There abounds also in this region whitish shelly granite, full of decomposing feldspar and near it, as might be expected, very fine white clays. Near the blue ridge we met with a lofty precipice of "Copperas Rocks," some of them so far decomposed as to have fallen down in huge masses. In Surry we found a bed of the earthy oxide of manganese; and in Stokes, a bed of plumbago of much the same quality as that in Wake, only not so slaty.

24. *Education.*—A committee of the Ohio Legislature to whom was referred that part of the Governor's message which relates to common schools, have (in their report) expressed it as their opinion, that the lands which have been

granted by Congress to that state for the support of schools, should be sold, and the proceeds vested in the stock of the United States, or in some other fund which shall be permanent and productive. The committee further reported, "that in order to collect information on the subject, submitted to their consideration, Commissioners ought to be appointed to report to the next General Assembly, a bill to establish and regulate common schools, accompanied by such information on the subject, as they may be able to collect."

25. *The blue Iris affords a good test liquor.*—Extract of a letter from Professor Olmstead of N. Carolina University. In my late experiments on the acids, wanting a test liquor, and red cabbage being out of season, I was induced to try the petals of the garden *iris*, then in blossom (I believe some people call it the *blue lily*, and others the *flower-de-luce*) I have never tried any test more sensible, or more elegant both for acids and alkalies. When prepared with care it is reddened by blowing through it, and still more by passing a stream of carbonic acid through it,—a sensibility which was confined by Bergman, and after him by Thomson and others to Litmus alone. Besides its greater delicacy, it has another great advantage over cabbage; its blue colour is permanent, or appears so, as far as I can judge from a tincture that has been kept for six or eight weeks; and from the size of the petals and the abundance of colouring matter they yield to diluted spirits, it is more convenient than violets. In a subsequent letter, Professor O. remarks; The colour faded after some weeks. It is necessary to mention that the petals afford the most delicate and sensible colour when they first put out; and the sensibility is further increased, by carefully selecting the part most richly coloured, and then, on infusing it, if the first tinge be greenish, by turning off the water and adding a new supply. For common experiments, however, the infusion will be sufficiently delicate and sensible without these precautions.

26. *Remedy for Hæmorrhage, especially Hæmoptisis.*—We have received from Mr. James H. Linsley of Stratford, the following statement of facts respecting the *Lycopus virginicus*, commonly called bugle-weed, and by some persons water-hoarhound. *It is, says Mr. L. found to be almost a sovereign remedy for internal Hæmorrhages.*

In consequence of a publication by Mr. L. in the Connecticut Herald, two years ago, about twenty persons afflicted with hæmoptisis, were restored to health by the use of the bugle-weed. The months of August and September are the proper time in which to collect the plant, of which a full description may be found in the books.

It grows spontaneously in most of the United States, in low and wet lands, and is a very common weed. The leaves are broad, and frequently of a bright purple; joints of the stem thicker upwards, stem quadrangular and branching, flowers opposite, sessile, white, and resemble those of the common hoarhound, (*Marubium vulgare*.) It begins to flower in August, and continues nearly through September—from eight to eighteen inches high.

Mr. L. remarks “I have been afflicted for some years with hæmorrhage from the lungs, and about five years since, was requested by Mrs. D. Porter, (sister of the late Pres. Dwight,) to drink a tea of the bugle-weed, made as strong as the common hyson-tea—to use it cold, and as often as I pleased. I did so, and found immediate relief; had no return of the complaint for two years—again resorted to the tea, and was again restored; and though I had bled for some days previous, had no relapse after using the tea. Whenever I perceived the symptoms of sudden bleeding, a violent flush in the face, pressure at the breast, &c. by drinking the tea, the symptoms were immediately dispelled. This I have done hundreds of times, when, I have reason to believe, that without its application, I must, in many instances, have raised blood.”

“I feel sensibly cooler after drinking the tea. In complaints of this kind, the circulation of the blood being unequal, and frequently giving a high flush to the face while the body and limbs are frequently shivering with cold, it would appear as if the essential quality of this plant is, powerfully, to equalize the circulation of the blood.”

“It is not productive of the same deleterious effects as *digitalis*, *laudanum*, &c. nor of any ill effects whatever, on me,

and I drank it more or less for five years, and on one occasion for three months together, as my only drink, both with food and otherwise; and what is remarkable, out of the multitude of persons whom I have known to use it, there is not one who is not happy to acknowledge its beneficial effects. Among them, I would beg leave to refer to a gentleman of eminence as a physician, in New-York, who addressed the following to Dr. Samuel L. Mitchell, a year after my paper had been copied into the *Evening Post*, and to which he doubtless alludes :"

"New-York, Sept. 5th, 1821.

"Sir,

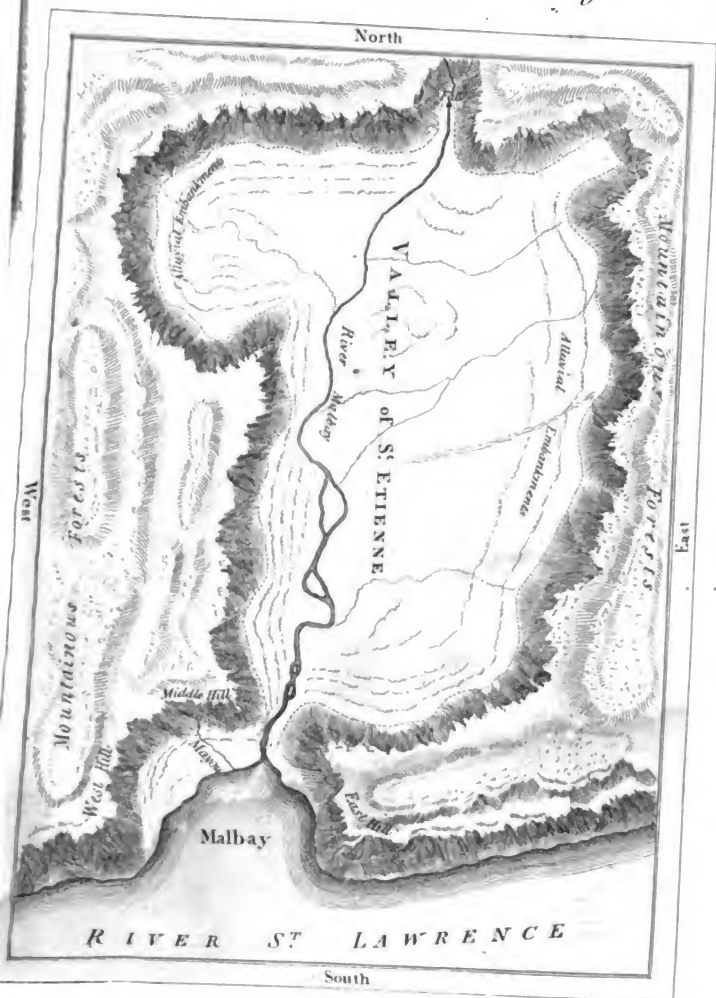
"I address you at the particular request of my son, the late Dr. John W. Wynkoop. His disease was consumptive, and in its progress he had repeated attacks of hæmorrhage from the lungs, or spitting of blood. To relieve this symptom, he drank a tea made of water-hoarhound, or *Lycopus virginicus*, called also Bugle-weed. It operated as a sovereign remedy against the inward bleeding, which it used to stop without fail; and it was his desire, during his last illness, that the beneficial effects of this remedy should be published to the world. His case affords confirmation to the statements that have already been made of its great virtue in hæmoptysis. My own observation shows that this native vegetable possesses similar powers in restraining blood from outward injuries: such as cuts and bruises, if applied to the wound in substance. Hoping this information may be serviceable to my fellow-creatures, I offer you the assurance of my respect.

"PETER WYNKOOP."

The plant and its great efficacy as a *vulnerary*, have been known in England for more than a century; it is there called bugle-weed. The first information I can learn of its use in this country, was about thirty years since. It was then used by an Indian in Windsor, in this state, to stanch the blood in an external wound from a scythe. Its good effects here were equally surprising. In this case it was *bruised soft, and applied to the wound*.

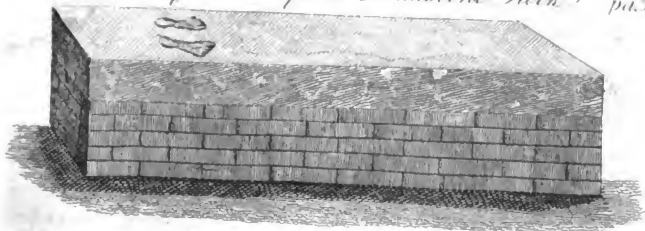
**Europæus* is distinguished by the calyx being acuminate-spined, flowers small, whorled, and the plant generally smaller than the *Virginicus*.

Outline of Malbay & the vicinity pa. 1.



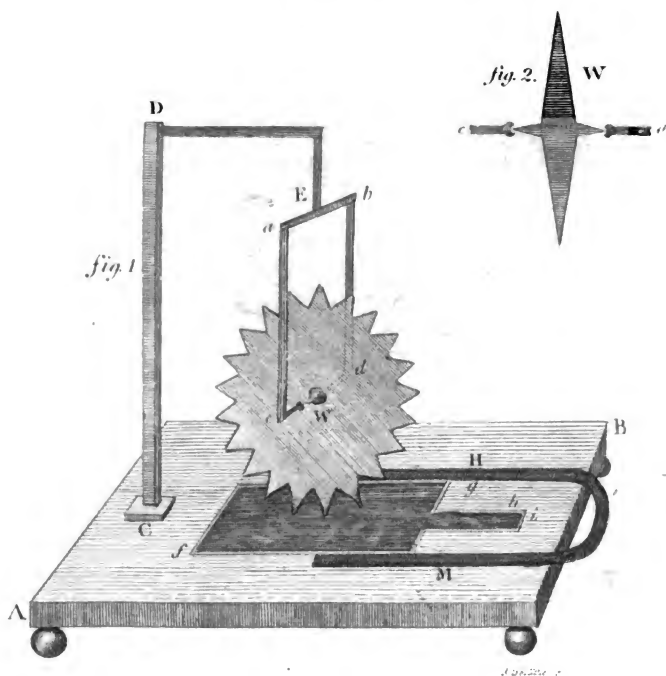


Impressions of Human feet in Limestone Rock, p. 23.



A. Doolittle sc

Electro-Magnetic Apparatus



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CONDUCTED BY

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PREFACE.

THE conclusion of a new* volume of a work, involving so much care, labour and responsibility, as are necessarily attached, at the present day, to a Journal of Science and the Arts, naturally produces in the mind, a state of not ungrateful calmness, and a disposition, partaking of social feeling, to say something to those who honour such a production, by giving to it a small share of their money, and of their time. The Editor's first impression was, that the sixth volume should be sent into the world *without an introductory note*, but he yields to the impulse already expressed, and to the established usages of respectful courtesy to the public, which a short preface seems to imply. He has now persevered almost five years, in an undertaking, regarded by many of the friends whom he originally consulted, as hazardous, and to which not a few of them prophetically allotted only an ephemeral existence. It has been his fortune to prosecute this work, without, (till a very recent period,) returns, adequate to its indispensable responsibilities;—under a heavy pressure of professional and private duty; with trying fluctuations of health, and amidst severe and reiterated domestic afflictions. The world are usually indulgent to illusions of this nature, when they have any relation to the discharge of public duty; and in this view, it is with satisfaction, that the Editor adds, that he has now to look on formidable difficulties, *only in retrospect*, and with something of the feeling of him, who sees a powerful and vanquished foe, slowly retiring, and leaving a field no longer contested.

This Journal which, from the first, was fully supplied with original communications, is now sustained by *actual payment*, to such an extent, that it may fairly be considered as an *established work*; its patronage is regularly increasing, and we trust it will no longer justify such remarks as *some* of the following, from the pen of one of the most eminent scientific men in Europe.* “Nothing surprises me more, than the

* Who, however, had seen only the four first volumes.

little encouragement which your Journal," ("which I read with very great interest, and of which I make great use,") "experiences in America—this must surely arise from the present depressed condition of trade, and cannot long continue."*

* Letter to the Editor, dated Dec. 5, 1822.

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ERRATA FOR NUMBER I, VOL. VI.

This Number of Vol. VI, and indeed the whole volume, was put to press during the unavoidable absence of the Publisher, and was found to contain inaccuracies which he can correct only by noting them in the following manner. Number II, of this volume, it is presumed will be found as free from errors as the nature of a scientific publication will admit. At any rate, the Publisher will effectually guard against a recurrence of a similar misfortune. He could only learn from experience, that a scientific publication could not be left with the same safety as ordinary works.

It is but just to remark, that many of the errors occurred from the illegibility, and some, from the inaccuracy of the manuscript. Some also are alterations from copy:

*Errata, in part first of Mr. Hitchcock's Sketch.**

Page 3	line 10	from bottom	for when read where
8	10		dele it
8			for attissimus read altissimus
10	19		for ruins read reins
12	10	top	insert the before Connecticut
	20		for Saussure read Saussure
14	2		insert the before feldspar

* We omit a few errata in the spelling of botanical names, as the corrections will be obvious to every botanist.

Page 15	line 15	from top	for <i>fine</i> read <i>firm</i>
17	1		for <i>few</i> read <i>face</i>
18	22		insert <i>it</i> after <i>east</i>
20	11	bottom	for <i>if</i> read <i>is</i>
22	19		for <i>slute</i> read <i>state</i>
	6		for <i>Hadley</i> read <i>Havoley</i>
24	19		for <i>particles</i> read <i>patches</i>
27	1		for <i>Oxford</i> read <i>Orange</i>
	18		for <i>West</i> read <i>New</i>
32	12		insert a period after <i>New-Haven</i>
	12	top	for <i>rich</i> read <i>rock</i>
34	3		for <i>bearing</i> read <i>leaning</i>
37	12	bottom	for <i>mica</i> read <i>mass</i>
38	13	top	for <i>none</i> read <i>nor</i>
42	11	bottom	for <i>form</i> read <i>former</i>
55	12		for <i>points</i> read <i>fronts</i>
	14		for <i>ledge</i> read <i>ledges</i>
59	11		for <i>amygdaloidal</i> read <i>amygdaloid</i>
62	5		delete the comma after <i>same</i>
70	1		for <i>on</i> read <i>and</i>
84	17	top	for <i>highest</i> read <i>largest</i>

In two or three instances the secondary greenstone is said to terminate in Northfield—but for Northfield, insert “Gill a little south of the meeting house.”

Errors in the coloring of the Map.

The most southern hill of greenstone in East-Haven is omitted.

Also a small range of greenstone in the same town, on the east side of Saltonstall's Pond.

Also an alluvial tract in the same town.

In some copies the greenstone and old red sandstone in Sunderland, Deerfield and Greenfield, have been made to *exchange places*.

The western branch of the Mount Carmel range of greenstone, which extends through Cheshire into Southington, is coloured as alluvion.

Errata in Mr. Barnes' piece on Shells.

Page 107	title	for <i>D. W.</i> read <i>D. H.</i>
109	note	for <i>Goor</i> read <i>Geor</i>
110	line 14	from bottom, after <i>multiplier</i> read <i>is</i>
111	13	for <i>cross</i> read <i>brass</i>
112	4	erase <i>when</i>
125	9	for <i>interiour</i> read <i>anterior</i>
127	17	for <i>small</i> read <i>smooth</i>
122	3 and 18	from top, for <i>heel</i> read <i>keel</i>
119	5	from bottom, for <i>Gass's</i> read <i>Cass's</i>

Errata in Mr. Orr's piece on the Universe.

Page 129	line 4	from bottom, for <i>sun</i> read <i>system</i>
130	16	for <i>its</i> read <i>their</i>
	10	for <i>direct</i> read <i>intense</i> , perhaps <i>also</i> should [be inserted]
134	22	for <i>or</i> read <i>on</i>
137	3	for <i>on</i> read <i>or</i>
139	4	for <i>atmosphere</i> read <i>atmospheres</i>
140	3	for <i>parts</i> read <i>part s</i>
143	6	top for <i>account</i> read <i>physieal account</i>
149	13	after <i>otherwise</i> the stop should be a period

Page 190, line 15 from top, for *Terebatrulæ* read *Terebatulæ*
 Passim for *Dr. Borré* read *Dr. Boué*.

Pa. 240,	line 4	from bottom, for <i>can</i> , read <i>cannot</i>
245,	1	top, for <i>communicated</i> read <i>communicated</i>
302,	bottom line,	in a few copies, for <i>auter</i> , read <i>auteur</i>
330,	line 14	from bottom, for 12, read 10
341,	17	top, for <i>Dr.</i> read <i>Prof.</i>

THE
AMERICAN
JOURNAL OF SCIENCE, &c.

GEOLOGY, MINERALOGY, TOPOGRAPHY, &c.

ART. I.—*A Sketch of the Geology, Mineralogy, and Scenery of the Regions contiguous to the River Connecticut; with a Geological Map and Drawings of Organic Remains; and occasional Botanical Notices. Read before the American Geological Society at their Sitting, Sept. 11th, 1822; by the Rev. EDWARD HITCHCOCK, A. M. of Conway, Massachusetts.*

PART I.

THE region embraced by the accompanying map, and to which this sketch is principally confined, is about 150 miles long and 30 broad; extending from New-Haven to Bellows' Falls. A leading object of this map is to give an accurate view of the secondary tract extending from New-Haven 110 miles northerly to Northfield. But it is protracted 30 or 40 miles beyond this, on the north, so as to embrace probably all the argillite along this river. A considerable extent of primitive is also exhibited on the borders of the secondary. The map is not colored according to the Wernerian distinctions of primitive, transition and secondary; nor according to Macculloch's division of rocks into unstratified and stratified: but an attempt has been made to give every particular rock that position and extent on the map which it actually occupies on this portion of the earth's surface. Every geologist knows, that perfect accuracy in these respects, on a map of such extent, would require a degree of labour and research, which, none but those whose whole time is devoted to such pursuits, could bestow. Indeed, so

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large a part of every country is covered with geest, and so imperceptible is the passage of some rocks into others, leaving the observer in doubt for miles which rock predominates, that after all, two equally good geologists would not probably fix the limits of different rocks precisely alike. And to exhibit all the minor salient and reentering angles which any rock makes on the surface, would require a map on a scale five times larger than that used in the present instance. In attempting, therefore, to give every rock that position and extent on the map which it actually occupies on the surface, I do not suppose I have done any thing more than to approximate to the truth. It is hoped, however, that the approximation is sufficiently close to answer most of the purposes of geology. I trust at least that this outline will furnish assistance to succeeding geologists.

In constructing this map I have derived very great assistance in the vicinity of New-Haven, from the researches of Professor Silliman, and of Dr. Percival. Indeed, could either of these gentlemen have been induced to form a map of that region, I should gladly have omitted the southern part. In the northern part of the map, I have been assisted by Dr. J. A. Allen, Lecturer on Chemistry in Middlebury College, and by Rev. J. Andrews, of Putney. Dr. E. Emmons, of Chester, has also communicated facts of importance.

The sides of the map are not precisely meridians; but incline 3 or 4 degrees to the right, as is evident from the *fleur de lis* attached to the upper right hand corner. The longitude and latitude are marked from those of Deerfield, which have been determined by numerous observations.

Having made these preliminary remarks, I now proceed to describe the several rocks occurring in this district, in the order in which they are put down in the explanation of the colours on the upper left hand corner of the map.

1. GRANITE.

Coloured purple—or a mixture of carmine, red, and Prussian blue.

Almost every variety of this rock described by geologists occurs in the region of the map, except the transition

granite of Norway and Scotland. Its texture varies from the coarsest to the finest grain, and it exists here in most of the forms that have been noticed.

East-Haven Granite.

The deposit of granite marked in East-Haven and Branford, has its southwestern extremity at the Lighthouse, which stands on a sea beaten rock of this description. The grain is intermediate between fine and coarse, and the felspar is usually reddish. In passing from East-Haven to Branford, we find the granite immediately succeeding the old red sand stone, or the slate rocks of the coal formation, or the greenstone; and all these rocks are nearly on the same level. Their actual contact with the granite, however, has not been observed, being hid by geest.

There is no evidence that this granite constitutes a bed in other rocks: On the contrary, it would seem, that it was brought to view along the coast by the abrasion of the gneiss and mica slate, which appear a few miles to the north, and which there lie at a much higher level. On passing east and northeast from this granite deposit, well marked beds of this rock appear; and perhaps all the granite which is found at the mouth of Connecticut river occurs in this form.

I do not know exactly how far the East-Haven granite may be traced along the coast. Certainly the gneiss reaches the sound before we come to Connecticut river.

In the cavities of this granite, when it is washed by the tide, one or two species of *Lepas* and other *testacea*, have fixed their abodes, finding security in those projecting crags which are so appalling and dangerous to the mariner. Some *Ulvae* and *Fuci*, also, are found along the shore.

South Hampton Granite.

Although the granite thus designated extends but a little distance into South Hampton; yet it contains the South Hampton lead mine, which will, no doubt, be long an increasingly interesting focus to which mineralogists will be

drawn—and therefore, the specific name above given, may not be inappropriate for this granite.

A great part of this granite exists in beds in mica slate; gneiss being a rare rock in the vicinity. Indeed, it may be doubted whether the whole range is not in the form of beds. I think, however, it will be found that there is a central ridge which is fundamental, at least two or three miles broad, extending from South Hampton through Williamsburg to the southwest part of Conway and northeast part of Goshen. Certainly, along this line little else appears but granite; and in some places, as at its northern extremity, this rock forms hills of considerable elevation, and extensive ledges. Beds of granite may indeed be found in the vallies between these ledges; but an observer as he passes over this region and proceeds south to South Hampton lead mine, will find it difficult to persuade himself that he is not traversing an original fundamental* deposit of this rock. Or if it exist in beds alternating with mica slate, it will in some instances be found no easy matter to prove it—the mere fact that mica slate is found on both sides of it not being sufficient evidence: the same being the case with an original deposit.

I would here suggest whether the mica slate of this region, that contains beds of granite, may not be a newer formation, reposing immediately upon that granite nucleus which probably forms the basis rock in New-England. And wherever this mica slate and upper granite is worn away, or there is a projection in the nucleus, the basis rock may appear. Such a supposition will account for all the appearances of the region we are now considering, which is coloured on the map as granite.

As we go east or west from what I have called the central ridge of this granite, the beds of this rock become more and more distinct, the mica slate, however, increasing in

* “The term fundamental, has, it should seem, been gratuitously predicated of a particular description of granite; for by the terms of the proposition, the bottom of this formation has never been seen, and consequently we have no means of determining whether it be fundamental or not.”—*Ed. Rev. Jan. 1820, p. 89.*

But, we should ask, whether it be not proper to say of space, that it is infinite, for the very reason that we cannot limit it? And with equally good reason, it would seem, we may say of granite that it is fundamental, because we have never found any other rock below a particular description of it.

quantity and the granite decreasing. In painting what is denominated the South Hampton granite, I have comprehended most of the Chesterfield and Goshen granite,* which has become celebrated on account of the interesting minerals found in it—although the mica slate in those towns occupies probably as much of the surface as the granite. The purple colour, or that which represents the granite, has not been extended so far as to embrace all the beds of this rock in this region; but only so far as the granite predominates. Where the mica slate is most abundant, I have put down this rock as covering the whole surface, although it might contain many beds of granite.

The inclination of the mica slate strata, or dip below the horizon, and consequently of the granite beds, varies from 20° to 90° : and thus frequent opportunities are afforded for observing the former rock pass under and over the latter. The width of the beds varies from the fraction of an inch to 100 rods: nay, perhaps to a mile or two. So that in the narrow beds, a single glance of the eye will present their roof and floor. In these thin beds there is rarely any fissure; but in those several hundred yards in width, are frequently observed regular and irregular divisions, as will be more particularly noticed hereafter.

These distinctly characterized granite beds are not confined to the region of the South Hampton granite. A few miles north, indeed, they disappear; but they may be traced southerly into Litchfield county, where they exist abundantly, and are sometimes found in hornblende, slate, and gneiss. A good example of the former may be seen in Granville, about half way between the churches in the east and west parishes; where the layers of hornblende slate are nearly perpendicular. Instances of their existing in gneiss may be seen in abundance on the east side of Connecticut river, in Pelham, Monson, Chatham, Haddam, &c. Indeed, we think the geologist who traverses New-England primitive rocks will often be led to enquire, whether all our gran-

* "We have visited these localities more than once, and have no hesitation in saying that more distinct and well marked beds do not exist in this part of the United States or Europe; and what renders the fact more interesting is, the distinctly stratified structure of some of them."—*N. Amer. Rev.* No. 29—p. 233.

ite does not occur in the form of beds or veins. We are not yet, however, prepared to believe any one could conclude that it does. East-Haven granite, Black Mountain, a part of Leverett range, &c. stand as yet in the way of such a supposition. Still less are we ready to adopt the recent opinion of a distinguished European geologist,* that *granite is not a primitive rock*, and that the only two rocks that are so, are mica slate and gneiss!

Thus have we in New-England, as in the east of Ireland, granite of a decided character alternating with mica slate. But this ceases to excite any surprize, since Von Buch and Jameson have given us an account of the strata of Christiana and Haddington.†

The texture of the South Hampton granite is generally rather coarse. There is, however, in this respect, a great variety. The felspar is usually of a fine white colour, and the quartz and mica a light gray. I do not here, however, speak of the granitic veins, some of which traverse the granite itself, and the felspar of which is sometimes flesh coloured. The beds of the South Hampton granite are not rich in minerals, except the lead mine in that town. The veins in this rock, however, contain the fine tourmalines and beryls of Chesterfield, and Goshen, and Haddam.

Black Mountain.

This lies in Dummerston, Vermont, and consists of granite. A geologist standing in Brattleborough on the argillite is surprized on looking northwesterly, and seeing only four or five miles distant, an abrupt mountain 500 or 600 feet

* Dr. Borré.

† Porphyry in immense mountains reposing upon lime stone full of petrifactions; a sienite over this porphyry, consisting almost entirely of coarse granular felspar, and in the same manner, a granite not different in its composition from the granite of the oldest mountains—granite above transition lime stone! Granite as a member of the transition formation!"—*Von Buch's Travels in Norway*, p. 45.

Order of the transition rocks around Christiana, beginning at the top and reckoning downwards.

1. Zircon sienite. 2. Granite. 3. Porphyry. 4. Sand stone. 5. Flinty slate. 6. Compact gray Wacke. 7. Compact slate and black orthoceratite limestone. 8. Granite. 9. Clay slate and limestone, probably. 10. Gneiss.—*Ibid.*

high, evincing by its white and naked head that it is gneiss or granite. On visiting it, he will find it to be a fine grained granite. In many parts, however, he will perceive such a tendency to stratification, that he may doubt for a moment whether it be not gneiss. But upon examination he will refer it to granite. The same remark will apply to granite in many other parts of New-England. It seems, and probably is, in many instances, intermediate between well characterized granite and gneiss.

Black Mountain is not many miles in circuit, and on the north and west, is succeeded by well characterized gneiss. This gneiss is quarried and forms underpinning and step stones; specimens of which may be seen in the foundation of the Meeting house in Brattleborough, East Village.

On Black Mountain I noticed some interesting lichens. The most monopolizing of these, are the *Gysophoras*. *G. vellea*, *papulose* and *muklenbergii*; (Acharius) in some instances actually cover precipices 30 or 40 feet high, and crowd one another notwithstanding, so as to force up their broad margins, giving them the appearance of a *chapeau de bras*. These species are found also on the granite in Montague, and on the greenstone in Deerfield, where occurs also *g. deusta*. On Black Mountain I likewise noticed in abundance *Enclocarpon miniatum* Ach. and several species of *Parmelia* and *Lecidea*. Near its top grows *Milium involutum* (nov. sp. Torrey, MSS.)

I cannot but detain the reader a moment to explain the strange nomenclature by which those were governed who originally gave to this granitic peak the name of *Black Mountain*. Every body in passing is struck with its snow white aspect, and cannot help enquiring the cause of it. I was told that in early days, it was burnt over and derived its specific appellation from this circumstance. Thus an accidental and ephemeral fact has fastened a name upon it which its constant appearance belies.

A similar remark might be made in regard to the name of another mountain in the same vicinity. A person standing in Brattleborough East Village, perceives directly east of him, on the east bank of Connecticut river, a venerable mountain 800 or 900 feet high, seeming almost to threaten him with its overhanging fragments. On enquiring the

name of it, he will be told it is *West River Mountain*. And on examination he will find that *West River* empties into the Connecticut from the west, nearly opposite this mountain.

Granite range passing from Amherst through Leverett, &c.

This granite is generally found at a low level. Almost every other rock in the southern part, excepting the alluvion, rises higher than this. Along the central and eastern parts of Amherst it is mostly covered by geest and alluvion. It appears, however, two miles south east of the Collegiate Institution, and I have no doubt that Seminary stands on this rock; although some bowlders of pudding stone appear there. Two or three miles north of the College, it emerges in abundance, and becomes broader through Leverett, which is perhaps one of the best places for examining it; especially when we consider its proximity there to pudding stone. Mount Toby, which is 800 or 900 feet high, lies on the western border of the granite and consists principally of a peculiarly conglomerate rock which appears to belong to the coal formation. This pudding stone rises 400 or 500 feet higher than the granite, and in the intervening valley the two rocks approach very near each other; although I have never been able to find the actual junction. The granite, however, near the pudding stone, occurs in beds in mica slate, and is separated from the pudding stone, by this mica slate, or by hornblende slate, which appears in the valley above named, or by an imperfect variety of sienite. The mica slate in this place, and indeed along the whole western border of this range of granite, near the northwest corner of the town, it becomes mere *quartzose slate*, having a slight glazing of mica, or mica in small scattered scales. This quartz is divided in two directions by seams oblique to the face of the layers, so as to separate the rock into very regular rhombs with different degrees of obliquity. In hand specimens, indeed, it seems to be limpid quartz in very perfect distinct concretions.

In the valley between these rocks appears to have been for ages a war of *avalanches* between the pudding stone and granite; in which

—————"hills amid the air encountered hills,
Hurl'd to and fro with jaculation dire,"

And evidently too to the advantage of the pudding stone: for this is several hundred feet the highest, is more steep and more easily broken up from its bed, so that its debris has evidently gained upon the older rocks, and subjected some of them to its dominion.

In this valley the lichens, mosses and fungi, have planted themselves thickly upon the bowlders and decaying logs where they are secured by the dense foliage of the trees from the too powerful rays of the sun and moistened by the vapour of a small brook which here finds a passage. You there see *Sticta pulmonacea* (Ach.) and *Jungermannia platyphylla*, fantastically fringing the rocks, while the ever verdant *Polypodium vulgare* frequently crowns the top. *Parmelia saxatilis*, *caperata*, and others, several *Lecanora* and *Lecideae*, *Peltidea canina*, *Poiena pertusa* *Ramalina fraxinea* and *Cenomyce coccifera* and *rangiferina* of *Acharius*, *Hedwigia filiformis*, *Bartramia crispa*, *Polytrichum perigoniale*, several species of *Hypnum*, *Dicranum*, *Orthotrichum*, and many other genera grow there. On the decaying trees along this valley, you not unfrequently may see the delicate *Boletus versicolor* and *betulinus*, the elegant *B. cinnabarinus* and *lucidus*, and the useful *B. varius*, *velutinus* and *igniarius*, (Persoon.) Here too may be found *Agaricus alneus* (Pers.) *Daedalea cinerea* and *Polyporus abietinus* of *Fries*; various *Thelephorae*, *Hydra*, *Clavariac*, *Pezizæ*, &c. And the margin of the brook has in many places a carpet of *Marchantia polymorpha* and *conica*. Near the northern extremity of this valley is a pond, in and around which are many rare and interesting phenogamous plants—such as *Drosera rotundifolia* and *longifolia*, *Nuphar advena* and *Kalmiana Nymphaea odorata*, *Utricularia striata* (n. sp. Le Conte) *Myriophyllum verticillatum*, one or two *Charae*, *Cnicus lanceolatus*, *attissimus arvensis*, *discolor* and *muticus*; *Rhynchospora glomerata* and *alba* *Najas Canadensis* and *Scirpus subterminalis* (n. sp. Torrey MSS.) In the outlet to this pond grows the singular *Spongia fluvialis* of Linnaeus.

But to return to the granite. Along the southern and central parts of Montague, it is greatly hid by the gneiss and mica slate. In the northern part of the town, however,

near the mouth of Miller's river, it appears in one or two detached eminences of considerable height; directly west of which, only a few rods, is another hill of puddingstone similar to that of Toby. The granite can be traced nearly all the way through Northfield at a low level, and in the north of this town it seems to pass under the geest and higher rocks, and to appear again in Winchester and Chesterfield, of greater width, and here it is beautifully porphyritic. As we go north, the rock exists in distinct beds in mica slate and gneiss, and also it appears at the tops of mountains sometimes forming conical hills almost naked. Witness the west part of Surrey and Alstead.

The texture of this granite is coarse, in some instances very coarse, the plates of mica being several inches across. Its usual colour is white. A beautiful variety, however, occurs in Leverett, in which the felspar, which is abundant, is of a light blue; the quartz of a dark blue, approaching to black; and the mica the usual light gray. This a rare variety, and a fragment of a crystal of this blue felspar measured in its longest direction 8 inches.

This range of granite contains several veins of metals, such as galena, copper pyrites, blende and iron; which will be more particularly described hereafter.

Much of this range exists in the form of beds and ruins: yet so far as I have examined it, it will not be easy to prove that the whole of it can be referred to this form. I am yet of opinion that along the central parts of the range may be seen emerging an original fundamental deposit of granite.

These are all the depositories of granite of considerable extent, which I have discovered in the region embraced by the map. Granite exists in many other places along this river in beds and veins; but not of sufficient extent to claim to be represented on the map. It is possible, however, that what I call beds and veins, may not in all cases be such: For it is generally allowed, I believe, that the basis rock in all New-England is granite, and this nucleus, if I may so call it, is doubtless very uneven, having many prominences and corresponding hollows. In some places, perhaps, these projections have never been covered by other rocks, such for instance, as black Mountain. In other cases there is every appearance to indicate that the higher rocks have been worn away, and thus the granite has been disclosed:

for in general, the granite along the Connecticut appears much lower than the neighbouring rocks, such as gneiss and mica slate. No person who examines the East-Haven granite, or that running through the Leverett, or even the South Hampton deposit, will doubt that some powerful agent has swept away an immense mass of superincumbent rocks of some description or other. Whether this was a primeval northeasterly current as Mr. Hayden maintains, I shall not undertake to decide. Be it, however, what it may have been, wherever it has acted powerfully we may expect to find the granite laid bare. If these remarks are correct, we need not be surprised to find this rock any where, even if we cannot make it form any thing like continuous ranges, and perhaps some of those small masses of granite, which every one who has examined New-England knows, appear so frequently, and which being surrounded by gneiss or mica slate, we are apt to refer to beds or veins may, after all, be the top of a projection of the nucleus of the globe which the abrading agent has laid bare.

Bellows Falls Granite. .

This is of quite limited extent; but the interesting nature of the spot where it occurs induced me to colour it and notice it thus particularly. Fall mountain on the east bank of the Connecticut at Bellows Falls, consists of a coarse, not very perfectly stratified mica slate. At its western foot in the bank of the river, the stratification becomes less distinct, and is at length, about the middle of the stream, entirely lost; and the rock becomes an imperfect granite. In other words, there is a graduation from the mica slate into the granite. In the western bank, in the village, the characters of the granite are more decided; though even here, I should have no hesitation in calling it a sienitic granite, did it contain any hornblende; but I could discover none. The mica is black and abundant, thus giving the rock a sienitic aspect; and it is also traced by veins of felspar and granite like the sienitic granite of Northampton and Belcher-town, to be described hereafter. The ingredients of this rock are arranged when viewed on a small scale somewhat in distinct layers; but when regarded as a whole, I never

saw a rock farther from *stratification*. Sometimes the felspar is wholly wanting, and the rock appears to be mere *unstratified mica slate*, if such a term does not contain a contradiction. It is of no great extent, being evidently laid bare by the waters of the Connecticut, which here urge their way in foaming fury over its ragged cliffs. The same rock occurs two miles east of the falls; but, as far as I examined it, it seemed to occupy no great space.

Stratification of Granite.

Probably the granite of Connecticut will leave the question* on this subject undecided. For some of it is evidently stratified and some of it is not. That which exists in not very extensive beds exhibits, so far as I have examined the subject, the most decided marks of stratification. It is not unfrequent to see the bed divided into layers parallel to its roof and floor, and from one foot to two feet thick. This is readily distinguished from gneiss by the much greater thickness of the layers and the want of a stratified arrangement of the ingredients. In other instances, more rare, however, we observe what Saussure would call vertical plates (*feuilletés*)—that is, thick tables of granite perpendicular to the horizon, crossing the bed sometimes at right angles and sometimes obliquely. These plates are also found making a dip to the horizon—In all these cases, however, the plates being parallel, or nearly so, the rock would be properly denominated stratified. Examples of these various kinds of arrangement may be seen in Conway, Williamsburg, Goshen, and Chesterfield. Yet the greater part of our granite is divided by numerous fissures into these irregular blocks that bid defiance to precise description.

Granitic Veins.

By veins I understand those zones of any particular rocks, or mineral, which traverse another rock, either rectangularly or obliquely to the direction of its strata. In *crossing* the strata they differ from beds.

* See Greenough's First Principles of Geology.—Essay 1.

Granitic veins are very numerous in many parts of the map, especially in the region of the South Hampton granite. In width they vary from a mere line to 30, and perhaps even 40 feet. But I have not observed any that exceed this breadth. They traverse mica slate, hornblende slate, limestone of a peculiar character, sienite, gneiss and granite. Those which traverse the latter rock differ from it only in being of a finer, or a coarser grain. Yet they are as really veins as those zones of granite traversing other rocks. Examples of these are frequent—as near the South Hampton lead mine.

In these veins all the ingredients of granite are usually present, but in variable proportion. I have seen some that were nearly or quite graphic granite: But usually the mica is in superabundance, especially in the narrower ones, and often it is of a delicate straw or light green colour, as in Goshen and Conway. The felspar is sometimes of an elegant flesh colour, especially in those veins occurring in the gneiss northeast of New-Haven, in Chatham, Haddam, &c. These veins frequently divide and subdivide like the top of a tree, some of the branches being smaller and some larger. These branches rarely go off from the main stock at right angles, but generally oblique. At one place you will see a vein retaining its width for several feet, or even rods, with mathematical exactness—at another, its width will gradually increase or decrease; and I have seen, in some instances, a sudden reduction of two or three inches, by which a shoulder was produced. The course of many of these veins is serpentine, resembling that of a river on a map—yet often they scarcely deviate at all from the right line. Sometimes they make large curves to the right or left. They usually descend into the rock obliquely to the horizon. They frequently intersect, but I have never noticed any displacement of the strata, or mass of the rock, except in the sienite. Some of the veins traversing sienite, (between Belchertown and Ludlow for example,) are so numerous and their intersections so many, that they form what the Germans call a *stock worke*, except that they are not metallic. By these cross veins the surface of the rock is sometimes divided into triangles, rhombs, or rhomboids; and sometimes it is tessellated.

The veins traversing sienite are most frequently granite, felspar being of a flesh colour. They are more numerous in this than in any other rock, and are often intersected by one another and by thin veins of epidote. The crossing of these veins has produced many very interesting and singular displacements of portions of the rock. Where one vein is cut off by the intersection of one that is newer, it is not unfrequent to observe a lateral removal of the former with the whole mass of the rock surrounding it, from one to six inches. The vein itself, which is thus removed, is rarely altered or injured.

One of the most complete and curious cases of this kind is exhibited in Fig. 6. It was sketched by the eye without accurate admeasurement. A. B. C. is a triangular mass of sienite; the sides of which are 6, 4, and 10 feet. A. B. is a fissure in the rock: B. C. a vein of epidote and A. C. the line marking the lowest limit of the rock above the soil. The whole rock is unbroken and as firmly united as any rock of this character ever is. There appear originally to have been two veins of granite traversing the rock in its longest direction, the smallest an inch wide at one end and widening towards the other, and the longest 2 or 2 1-2 wide. These have been cut through and strangely displaced by numerous veins of epidote crossing obliquely.

a, a, a, and *b, b, b,* &c. represent the granite veins as displaced.

d, d, d, &c. represent the veins of epidote which are rarely more than one quarter of an inch thick, and a few of which are represented on the plate.

c is a mass of gneiss or mica slate imbedded in the sienite and crossed by the granite vein *b*.

The locality of this rock will be described when we come to speak of sienite.

In those rocks that are stratified these veins make every possible angle with the direction of the strata. And if I do not mistake, the nearer they approach to the same direction as the strata, the broader they become, and have a nearer resemblance to beds. Sometimes they approach so near the same course as the layers of the rock they traverse, that it requires nice examination to determine whether they deviate at all. A good example of this occurs in a locality which many geologists have visited, and which many more

will probably visit. I refer to the main body of that enormous vein containing the green tourmalin, rubelite, &c. in Chesterfield. We think it might even admit of a question whether this be a bed or a vein.

The veins of which we are now speaking are doubtless contemporaneous ones—that is, such as were consolidated at the same time with the rocks they traverse. There is no seam or layer of another rock at their sides, but they are usually so firmly united to the rock which contains them, that they are separated from these with as much difficulty as they are broken in any other direction. I have, however, frequently noticed a seam traversing the middle of the vein—so that if the rock they traverse be broken up, one half will cleave to one side and one half to the other.

A real *lusus naturae* exhibiting the fine cohesion of these veins to the rocks they traverse, now lies before me. A slab of granite being a vein $2\frac{1}{2}$ inches thick, 10 inches broad, and 20 inches long, curved a little upwards at one end, forms the base of the specimen. From the centre of this, rises perpendicularly a bladed, taper-pointed column of a peculiar limestone, only 2 inches thick, 10 inches broad at the base, and 26 inches high, appearing as if mortised into the granite. The contrast between the light coloured granite and the dark gray limestone, is very striking. The secret of its having been brought into this singular form appears to be this. It was found in a mountain torrent in Conway, and the granite doubtless once formed a vein in the limestone. On one side the limestone has been entirely worn away by the water—and on the other side, it is worn so as to leave only the bladed column above described, which still adheres firmly to the granite.

I have said that these granitic veins are contemporaneous ones: And it would seem that the judgment of no man could be so warped by theory, as to believe, after examining them, that they were once fissures made in the rocks they traverse, *after these were consolidated*, and that these fissures were filled by a solution of water above, or by a fiery furnace beneath. There is just as much reason for believing that one of the constituents of granite, quartz for instance, was introduced into the rock in this manner after the other constituents were consolidated; or that the imbed-

ded crystals of porphyry are not of the same age with the base.

Granitic veins are numerous in many parts of the map. Commence at Conway and go south, and they will be found in abundance nearly to the ocean. North of this town I have never noticed any. On the east side of Connecticut river, also, they are not unfrequent, particularly in Connecticut. Many of the interesting minerals of Had-dam and Chesterfield occur in them.

Veins of quartz are sometimes seen in this region traversing granite, as in Conway. But they are not extensive, or numerous. I have noticed also that sometimes the granite contains, imbedded in it, masses of mica slate having a curved form and not rounded; as on the top of the high hill between Williamsburg and Chesterfield.

Graphic Granite.

This is a rock not uncommon in the region of the map. I shall notice two of the finest localities. The first is in the red conglomerate, or coarse sand stone, passing through Deerfield. The imbedded masses in this rock are sometimes the most beautiful graphic granite. The felspar, although it retains its lustre most perfectly, appears to be thoroughly penetrated by the colouring matter of the conglomerate so as to become of a deep flesh colour. The quartz is gray and limpid, or a little smoky, and being arranged somewhat graphically, many of the specimen are truly elegant.

The other locality of this rock, is the Goshen granite, in the northeast corner of the town. The felspar is of a snow white, and the quartz limpid; and so perfectly graphic is its arrangement, that it bears a close resemblance to the Chinese or Hindostance characters which are frequently observed on goods from the East-Indies.

Porphyritic Granite.

This handsome rock occurs in great abundance in loose rolled pieces along the range of granite passing through Leverett, &c. The crystals of felspar are from one to two inches long, and a half or three quarters broad, and some-

times the few presented is a square. Thus an idea is conveyed to the observer, at first, that the crystals are rectangular parallelipeds and cubes; although it is well known that felspar never crystallizes in either of these forms. The felspar of these imbedded crystals, when broken, exhibits the pearly lustre of the folia very well. The granite containing these crystals is almost uniformly of a coarse texture.

This porphyritic granite is carefully to be distinguished from glandulous gneiss, which also occurs abundantly along the Connecticut. Let any one pass from Hinsdale, New-Hampshire to Winchester and he will see numerous bowlders, often ten feet diameter, of a rock having the granite constituents and exhibiting no appearance of a schistose structure. In one place at least he will cross the rock in place; and he will have no doubt that it is the most decided granite. And yet it is elegantly porphyritic. This rock occurs also in Chester where Dr. Emmons has traced a range of it five or six miles. Numerous bowlders of this rock are scattered over the town of Woodbridge near New-Haven: but I do not know from whence they originated.

Pseudomorphous Granite.

I put this adjective to a variety of granite that occurs along the Connecticut, not to show my dexterity at coining new terms, put to make myself understood. I am inclined, however, to think that the rock to which I refer is not exactly described in the geological books which I have seen, unless it be by Cleaveland, when he says, "some varieties (of granite) are divisible into imperfectly columnar or tabular concretions." (Mineralogy, vol. 2, p. 732.) It is a coarse grained granite with light coloured quartz and feldspar, arranged in the usual manner. The peculiarity lies in the mica. This is usually dark coloured, and arranged in plates from one to three inches across. The manner in which these are disposed, may be thus explained. Suppose the quartz and felspar to have been cemented together so as to form a perfect graphic granite. Next suppose the mass to be cut in various directions by a fine saw; and in the spaces thus made, imagine thin plates of mica, not more than $\frac{1}{50}$ of an inch thick, to be fitted. It is obvious that the

mass will thus be cut up into segments of pseudomorphous crystals. And so it is in the natural specimens: and it seems as though the hand of nature had really made use of a saw in their construction. The plates of mica meet at various angles, yet never cross each other; and the smallest piece of quartz or felspar is sometimes bisected, so that a part appears on one side of the plate of mica and a part on the other. This rock occurs in the S. Hampton granite; and may frequently be found in other parts of the region extending fifty miles south from Conway. At a little distance the dark bronze coloured mica appears like prisms of some imbedded mineral: and the travelling geologist is often tempted from his carriage in the almost certain expectation of obtaining from this rock shorl or titanium.

2. GNEISS.

Coloured Orange.

Although this is the most abundant rock in New-England, yet the map includes no very extensive portion of it. It stretches over a broad region without the limits of the map on the east and west, especially on the east. On the west it forms a part of the Hoosack or Green Mountains; though a much less part than has been usually supposed. On the east appears with some interruptions of granite, mica slate, &c. within twenty or thirty miles of the coast, and on the north it spreads over a considerable part of New-Hampshire. The White hills are said to consist chiefly of this rock: though they have not, I believe, been thoroughly explored.

The dip of the layers of gneiss in this region varies from 20° to 90° —and it dips, like most other stratified rocks along the Connecticut, to the east. When it approaches to hornblende slate the dip is generally greater than when pure. This rock often contains crystals of hornblende; in every proportion, indeed, until the characters of gneiss are lost in hornblende slate. Especially is this the case on the east side of Connecticut river. More, however, will be said on this subject when we come to describe hornblende slate. Good examples of this gneiss containing detached crystals and even veins of black hornblende may be seen in the basement of the new Collegiate Institution in Amherst. It fur-

nishes an admirable stone for such purposes; and many quarries are opened in it. Immense tables of it may be procured, and should the mania for constructing pyramids ever seize the inhabitants of New-England, this gneiss might produce masses of stone rivaling in magnitude the immense limestone blocks of the pyramids of Egypt.

The gneiss of the Connecticut, often alternates with mica slate, and passes into it. In Granville, may be seen gneiss, hornblende slate and mica slate, in various stages of approach to each other, and making various alternations.

This mixture of gneiss with other rocks, and the consequent indistinctness of character, render it, in some instances, not very easy to give its limits. I have felt this difficulty especially in regard to the northern part of that gneiss range which occupies the eastern part of Litchfield County and appears so decided in its characters in Bristol, Plymouth, and Canton. In the west part of Granville, I feel confident gneiss is the prevailing rock—although mica slate alternates with it. Yet between Chester and Westfield there is nothing but mica slate, as the prevailing rock, which extends twelve or fourteen miles west of Chester, before we come to gneiss. And north of this we find very little gneiss within the limits of the map except a narrow stratum as we ascend the hill from Cummington to Goshen. I do not, therefore, feel exactly satisfied with the northern termination of the Litchfield gneiss as given on the map: but at present it is not in my power to re-examine it.

I would here, however, suggest that I have been rather inclined to believe that some of the stratified rocks along the Connecticut pass gradually into other rocks *laterally*, that is, *in the direction of the strata*:—mica slate, for instance, into gneiss, or hornblende slate; and argillite into mica slate. To establish this fact, however, requires a long series of very close and accurate observation. I merely suggest it, therefore, and do not assert it.

In some instances, the ingredients of our gneiss are pretty equally mixed: in others they are arranged in somewhat distinct layers, which are generally straight. It is not a rock that is rich in minerals with us. Veins of granite traversing it, however, sometimes contain interesting specimens. Witness the Haddam minerals.

Glandulous Gneiss.

This is very abundant, especially in the gneiss east of Connecticut river. Indeed, a considerable proportion of that range is occasionally glandulous, presenting numerous oval masses, chiefly of felspar. The layers of this variety of gneiss are usually very distinct, and it contains a large proportion of mica, which is usually of a blackish colour; and thus it is easily distinguished from the porphyritic granite above described.

3. HORNBLENDE SLATE, CLEAVELAND.

Coloured Vermillion, Red, and clouded with India Ink.

This is an anomalous and perplexing rock. It is not generally well characterised in this region: but I have put it down, because a rock approaching nearer the characters of this than of any other, occurs in considerable abundance along the Connecticut. I have no confidence however that I have given in all cases its exact situation or extent. Yet I believe that wherever this stratum is coloured on the map, the rocks may be found in the vicinity. Thus in the range extending from Belchertown to Guilford, Ct. a person will generally find this rock more or less abundant in crossing from the secondary rocks to the gneiss: but sometimes he may thus cross and miss of it, unless he make an excursion to the right or left; and sometimes he must cross a portion of the gneiss before he reaches it. The continuity of the strata of this rock seems to be much less perfect than in the gneiss or mica slate, and the direction of the strata is often oblique to that of other rocks:—a remarkable instance of which occurs in the south east corner of Halifax, Vt. The dip of the strata varies from 45° to 90° , and the schistose structure in the purest specimens is very perfect, the layers varying in thickness from half an inch to three inches.

But there is another difficulty in ascertaining the limits of this rock. It is no easy matter to draw the line between it and gneiss, all, or at least, two of the ingredients of the latter rocks being sometimes present, while more than half of the rock is hornblende. Indeed, I have sometimes been dis-

posed to regard this rock as gneiss containing an accidental proportion of hornblende; and this would have been a satisfactory description of a considerable part of the rock which I have called hornblende slate. But another part appears to be decidedly that species of Werner's primitive trap described under the name of hornblende slate in Rees *Cyclopedia*, *Article Trap*—that is, it consists of hornblende, generally fibrous and crystalline, having a very distinctly slaty structure. For localities of this well characterized hornblende slate I would mention the eastern part of Halifax, Vermont, also New Fane and Belchertown, two miles north of the meeting house on the west side of the road, and in the western part of Tolland and Monson.

I think however that the largest part of this rock will be found to consist of hornblende, quartz and mica—the latter being usually black and very apt to be confounded with the hornblende, so that perhaps it deserves the name of a granitic aggregate. In some instances, also, this rock contains chlorite, and verges towards greenstone slate. It is often strangely intermixed, and alternates with gneiss and mica slate.

Another portion of this rock has a porphyritic aspect. I use the term porphyritic in this place, not in the usual sense, as denoting a compact ground with imbedded crystals, but as a "granite ground, in which some crystals are much larger than the rest." (*Bakewell's Geology*, p. 28.) The slaty structure of the rock, though less distinct, is not lost: but the imbedded fragments, or imperfect crystals of quartz or felspar, most frequently the former, give it a porphyritic appearance. These imbedded fragments are frequently granular, while the base is distinctly crystallized. A good example of this variety of rocks occurs in the west part of Chatham and in Shelburne. Sometimes this rock becomes the real sienitic porphyry of authors—its slaty structure being lost. This occurs in Plainfield, in Hawley, a few rods west of the meeting-house, and at the falls in Deerfield river in Shelburne.

These porphyritic rocks, however, must be quite different from any thing occurring in Europe by this name, if a remark of Brongniart be correct, that "we are not at present able to find a sienite or porphyry which is evidently primitive." For we have as much evidence of the primitive char-

acter of the rocks above described, as of the mica slate and gneiss with which they are associated and in which they sometimes form beds.

Hornblende slate occurs on the west side of Connecticut river, south of Shelburne, in Massachusetts and Connecticut, also at Plainfield and Hawley. But it is not abundant or well characterized generally, and is much mixed with, and passes into other rocks; and therefore I have coloured it only in the range from Belchertown to Guilford and from Shelburne northward. Good examples of the rock containing quartz and some mica may be seen in the flagging stone of the side walks along the eastern side of the Public Square in New-Haven, and in other parts of that city.

4. MICA SLATE.

Coloured Green.

This is an extensive stratum in the northern part of the map. On the west side of the river it forms the prevailing rock; and its width continues to increase northerly, so that it occupies the principal part of Vermont. Prof. Silliman in his "*Tour between Hartford and Quebec*," says that he crossed this slate obliquely from Burlington to Hanover, a distance of 84 miles, and found mica slate by far the most abundant rock on the route. (*Tour*, &c. p. 386.) In Connecticut, however, along the river, this rock constitutes no very broad ranges. Those which are coloured immediately in contact with the secondary on both sides of the Connecticut are in most places quite narrow, often not more than half a mile, or even but a few rods wide, and sometimes they wholly disappear and we pass from the sandstone immediately to the hornblende slate or gneiss.

The dip of our mica slate is variable from 20° to 90° . In Vermont it is usually less than in Massachusetts; especially where we first strike it in passing from the river. Farther south, as in Hadley, Plainfield, Chesterfield, &c. it approaches 90° . East of Chesterfield the layers of this rock lean to the west. Beyond Chesterfield, on the west, they lean the contrary way—that is, to the east. The same is the case between Chester and Westfield. This fact looks like an indication of a fundamental ridge of granite, extending in

that direction, as we have already suggested; although it may not yet have made its appearance above the later rocks the whole distance.

This rock is somewhat Protean in its appearance; yet not very difficult in most cases to be distinguished by careful observation. The following varieties have been noticed in this region. 1. A variety already referred to, as occurring in Leverett, near the pudding-stone; which is scarcely any thing more than imperfectly limpid quartz, divided into distinct rhombic concretions, about an inch thick, and three or four across the outside, slightly spangled or glazed with mica. 2. Very much like the last, except that it does not divide into complete rhombs, but is only separated by seams oblique to the direction of the strata, and nearly perpendicular to the horizon*—Locality, West-River mountain in Chesterfield New-Hampshire. 3. Divided as the last by two sets of parallel planes, forming angles with each other a little oblique: But the mica is intimately disseminated in fine scales through every part of the rock, and the quartz becomes a mere siliceous sand, blended closely with the mica. Surface rarely waving—Locality, Whately, Conway, &c. 4. Not regularly divided in any direction, except that of the strata, and much less fissile than the last. Mica scattered in fine scales through the mass, and the silex more abundant than the last—Rock breaking into huge blocks, from one to three feet thick, and often forming, like greenstone, abundance of debris. Locality, West-River mountain and Deerfield. These four varieties occur on the borders of the secondary rocks. 5. Tortuous, wavy and extremely irregular, embracing numerous beds and amorphous masses of quartz—Mica, very imperfectly characterised, forming a kind of glazing with the aspect of plumbago. Locality, Conway, Shelburne, Colrain, &c. 6. Quartz and mica in somewhat distinct layers—quartz predominating, and mica not very well characterised—abounding in garnets—Locality, Plainfield, Hawley, Conway, &c. 7. Passing into talcose slate—mica abundant, having somewhat of a fibrous aspect and connected with talc. Northfield and Hawley. 8. Passing into argillite. Locality, Leyden, Ches-

*“When one set of parallel planes crosses another, are both sets to be called strata, or neither, or only one of them?”—*Greenough's Geology, Essay 1.*

terfield, (N. H.) Putney, &c. 9. **Not** very fissile—breaking into thick blocks. Mica, abundant but poorly characterised—having somewhat the aspect of argillite—surface slightly irregular, appears as if grooved—Abundant in Cummington, Chesterfield, (Mass.) Vernon, Bolton, &c. 10. Quartz granular, abundant and white—resembling gneiss or granite—scarcely stratified at all—Locality, Buckland, Granville, &c. 11. Mica in distinct and abundant plates—layers very little tortuous or uneven. This usually lies next to granite. 12. Passing into gneiss—often rendered porphyritic by crystals of feldspar. Locality, Litchfield county.

The quartz that occurs in this mica slate, especially in the wavy and tortuous varieties, is commonly the white limpid: frequently it is the fetid, and sometimes a rich variety of a delicate red color. The coloring matter, however, is apparently iron, and therefore it is not the rose-red quartz. This variety of quartz occurs on the west side of the Connecticut.

It has already been remarked, under granite, that numerous beds of this rock are contained in mica slate. Indeed, our mica slate more frequently rests immediately upon granite, without the intervention of any other rock, than does gneiss. It also alternates with gneiss, hornblende slate, argillite and chlorite slate. Small particles of it, indeed, occur in very many places throughout the whole extent of the primitive along the Connecticut.

It is a common remark in geological books, that hills composed of mica slate are usually less steep and more rounded than those of granite. But the reverse is the fact in most cases along this river. The granite hills are generally low and rounded, while some of the most Tarpeian precipices to be found in this region are composed of mica slate. Take for examples West River Mountain, and the high hills of Heath, Hawley, Chesterfield, &c.

Mica slate is not wanting in a variety of minerals in this section of the country—such, for instance, as staurotide and garnets in immense quantities in Goshen, Chesterfield, Mass. and from Bolton, Conn. one hundred miles north, to Chesterfield, New-Hampshire. Also the fine Chesterfield sapphire. Also the red oxid of titanium, found almost every where between Conway and Brattleborough, a distance of thirty miles—and the Leyden tremolite—the Putney

green fluor spar, and the Wardsborough zoisite. The Chatham Cobalt mine occurs in mica slate.

The cryptogamous plants that usually overspread a great part of the mica slate of this region, though perplexing to the mere geologist, are yet interesting to the botanist. Among those which adhere to these rocks, or to the little soil that collects in their cavities, may be named, *Bartramia gracilis*, Smith, *B. longiseta*, Mx? *B. crispa*, Swartz, *Hedwigia filiformis*, P. Beauv. in great abundance; *Arrhenopterum heterosticum*, Hedw. *Buxbaumia aphylla*, Lin. *Fissidens adianthoides*, *Bryum roseum*, *Diphyscium foliosum*, Spreng. *Polytrichum perigoniale*, Mx. *Jungermannia complanata*, L. *J. platyphylla* L. *Cenomyce phyllaphora*, and *pyxidata*, Ach. *Stereocaulon paschale*, *Parmelia herbacea*, *saxatilis* and *caperata*, *Porina papillosa*, and *perusa*, *Peltidea apthosa* and *scutata*, and *Sticta pulmonacea*, all of Acharius. In the region of the mica slate, especially in Brattleborough and Conway, we frequently find *Bryum cuspidatum*, Brid. *Hypnum minutulum*, Mx. *H. flexile*, Brid. *H. serpens*, L. *H. cupressiforme*, Hedw. *Jungermannia nodifolia*, Torrey, *Maschalocarpus trichonitrium*, Hed. *Pterigonium subcapillatum*, Brid. *Neckera minor*, Brid. *N. pennata*, Hed. *N. viticulosa*, Hed. *Cenomyce coccifera*, *rangiferina*, *botrys*, &c.—*Parmelia colpodes*, *ulothrix*, *cyclocelis*, *parietina*, *plumbea*, &c.—*Lecanora tuberculata*, *subfusca*, *brunnea*, *albella*, &c.—*Lecidea parascena*, *cameola*, *demissa*, &c.—*Usnea florida* and *plicata*, *Cornicularia fibrillosa*, *Collema tunaeformis*, and *Alectoria jubata*, all of Ach. *Nephroma resupinata*, Spreng. *Glonium stellare*, Muhl. *Polyporus abietinus* and *squamosus*, Fries. *Hydnum quercinum* and *cyathiforme*, Fries. *H. imbricatum*, *occanum*, *coralloides* and *gelatinosum*, Pers. *Thelephora quercina* and *terrestris*, *Cyathus olla* and *striata*, *Stemonitis fasciculata*, *Boletus citrinus*, *badius*, *brumalis*, *nigro-marginatus*, *cinnabarinus*, *velutinus*, *betulinus*, &c. all of Persoon, and many scores besides of *Agaricus*, *Amanita*, *Sphaeria*, *Peziza*, *Daedalea*, *Helvella*, *Lycoperdon*, *Bovista*, *Scleroderma*, *Tremella*, &c. too numerous to mention in this place.

Scattered among the mica slate rocks we frequently find the *Helix allolabris*, Say, or common snail; and also in some situations, *H. alternata*, Say. In a pond in Ashfield is found *Planorbis bicarinatus*, Say, and *Cycas similis*, Say.

In springs occurs a species of *Lymnaca*, Say, and in our larger streams, *Planorbis trivolvis* and *Unio purpureus*, Say, or common river clam.

5. TALCOSE SLATE. *Rees Cyc. Bakewell.*

Talcose Schist. Maccullock.

Talcose Slate. Eaton.

Colored Gamboge yellow, and dotted with India Ink.

Bakewell defines this rock to be "slate containing talc," (Geology, p. 491,) and Eaton calls it "that kind of mica slate which is distinguished from mica slate by a kind of talc glazing." In this term I do not include soapstone.

There is but one stratum of this rock in the region of the map, of sufficient extent to render it necessary to delineate it. I have sometimes noticed on the east side of Connecticut river a kind of talco-micaceous slate: but not in abundance, and rarely in place. I have crossed the stratum which is colored on the map in Whitingham, Vt. where it is not less than a mile and a half in width. I have traversed it also in Hawley and Plainfield, and Professor Eaton says it extends into Worthington—so that on his authority I have extended it thither. The rock is of a much lighter color than mica slate. At a distance, indeed, it has the aspect of gneiss. The talc is nearly white, though sometimes of a light green, and it contains a large proportion of silex. The strata are but little undulating and nearly perpendicular, leaning a few degrees to the west. On its east side, where it passes into mica slate, an intermediate talco-micaceous rock is found, containing numerous distinct crystals of black hornblende, thrown in promiscuously, and exhibiting the most elegant specimens. One variety has a ground that is green; another has a white ground, and the contrast between these and the imbedded crystals is striking. Large slabs of this rock may easily be obtained; and if it will admit of a polish, it would certainly be a beautiful addition to those marbles and porphyries that are wrought for ornamental purposes. The varieties of this rock may be seen in any direction a few rods from the meeting house in Hawley; as likewise many

other singular and curious aggregates which I have never seen at any other place. Among these is sienitic porphyry—and sometimes the talco-micaceous rock has its surface covered with delicate fascicular groups of hornblende.

The micaceous iron ore occurs in the talcose slate, and I have never seen any of this sort of ore in any cabinet that will compare at all for beauty with that in Hawley.

6. CHLORITE SLATE. *Cleaveland.*

Uncolored, but dotted with black.

In the region under description, I know of but two deposits of this rock of sufficient extent to be marked on the map; viz. at West-Haven and Milford* and in Whitingham, Vt. At the former place it is but imperfectly characterised, especially at its Northern extremity. As we approach the coast, in West-Haven, its characters become more decided, and here we find numerous small crystals of octahedral magnetic iron ore disseminated through it. Where the cliffs of this slate have long been buffeted by the waves of the ocean, these crystals have been worn out, and are deposited in large quantities, in the form of iron sand, on the beach. On the east side of West-Haven harbour, at the Light House, also, this sand appears in equal abundance—and tons of it may easily be collected. On that side of the harbour there is no chlorite slate; and whether the iron sand found there is the remnant of former chloritic strata now wholly disintegrated, or whether it is washed up from the bottom of the Sound, where these rocks doubtless exist, remains problematical. The latter supposition, however, seems most probable.

The chlorite slate of West-Haven is extremely tortuous and undulating, and is traversed by numerous irregular seams of white quartz. It alternates with greenstone slate and passes into it; and also with mica slate. These three rocks are often so blended together that the distinctive characters of each are lost. And as we approach the strata of the Verd Antique, they seem to embrace also some of the prop-

*West-Haven and a part of Milford have recently been incorporated into a separate town by the name of Oxford.

erties of this, and often to pass into it. Hence it is no easy matter, in many instances, to give a name to the Milford slate rocks, and the alternations above named, and also with unstratified primitive greenstone, are numerous—so that it was not possible in coloring the map to give to each of these rocks the precise situation which they occupy on the surface.

The direction of the chlorite slate strata, of which we have been speaking, is from north-east to south-west. They dip to the south-east, and their angle of depression below the horizon rarely exceeds 30°. Sometimes, however, it is 90°. I think it will be found that the rocks of Woodbridge and Milford pass laterally into one another. Thus, the chlorite slate at its northern extremity is usually somewhat talcose in its appearance, approaching to argillite, and as you pass south, its characters continue to be more and more developed.*

The chlorite slate colored in Whitingham, is the best characterised I have ever seen in New-England. It seems to be nearly pure chlorite, yet distinctly stratified, the layers being nearly perpendicular, leaning, however, a few degrees to the west. I know but little concerning the extent of this stratum. Where I have crossed it, it was less than half a mile in width. I have given it a place principally to excite an attention to it.

This rock also occurs in beds in argillite in Guilford, Vt. but they are not extensive.

7. SIENITE. *Cleveland.*

Colored Gamboge Yellow, and crossed by oblique parallel black lines.

This rock is marked in three places on the map. The first is in Whateley and of very small extent—the second extends from Whately to the south part of Northampton; and the third is in Belchertown and Ludlow. The rock in the two last places is very much alike, being for the most part a kind of sienitic granite. In the first mentioned locality the rock is considerably different from that in the oth-

*I am indebted to Prof. Silliman for this suggestion.

ers. I shall confine my remarks principally to that range extending from Whately to Northampton, because I have examined this most.

As above remarked, this range appears to be mostly a sienitic granite, that is, a modification of granite; and very different from that sienite which is associated with graywacke and greenstone. A person coming from the west or north-west towards the village of Northampton, will pass over the most decided granite, associated with mica slate, till he comes within four or five miles of that place. He will then find the texture of the rock to be finer, and in some instances it contains a portion of hornblende, while the proportion of quartz is somewhat diminished, the felspar frequently becomes red. Veins of graphie and common granite, epidote, &c. are more numerous, and the rock appears more disintegrated than the coarse grained granite. In one part of a mass of this rock, may frequently be observed a considerable proportion of hornblende, thus giving the rock a sienitic aspect, while in another part, only a few feet distant, this mineral is wholly wanting. Coming nearer Northampton, however, we find the hornblende more and more abundant, until we arrive at the eastern edge of the range, where we find a rock containing little else than felspar and hornblende, forming a real sienite. I have never yet seen a specimen, however, in which careful inspection could not discover both mica and quartz. The felspar is usually deep flesh colored, and the hornblende sometimes black and sometimes green. On the eastern border of this range, especially about two miles north of the village of Northampton, on the west side of the stage road, this sienite assumes a trappose and somewhat columnar form, both among the loose masses and those in place.* Among the *debris*, the three sided pyramidal form is most frequent; sometimes we find a three sided prism, and sometimes, both among the loose masses and those in place, two, three or four faces of a prism of a greater number of sides.

Another spot for observing some interesting facts in regard to this rock, is the south part of Whately. Two miles south of the congregational meeting-house, on the road to

*This fact was first mentioned to me by that indefatigable and able naturalist, Mr. Thomas Nuttall.

Hatfield, is a manufactory of common earthen ware, and here a small stream, running east, has cut across the greater part of the sienite range, and laid the rock bare nearly the whole distance, which does not much exceed half a mile. Let a person follow up the south side of this stream, and in some of the ledges he will perceive a distinct stratification of the sienite, though of little extent; one part of the same ledge being often stratified and the other amorphous. In this place he will see, also, numerous intersections of granitic and other veins by which a part of the rock has been displaced. In one of the ledges a little distance from this stream, on the south side of a pond, may be seen the prototype of Fig. 6.

Another interesting fact may be noticed in the sienitic granite along this stream, especially on the northern side, near the earthen ware manufactory. *The rock here contains numerous imbedded masses of other primitive rocks, as gneiss, mica slate, quartz, hornblende, and a finer kind of sienite.* And what is peculiar, is that these imbedded fragments are almost uniformly rounded—as much so as those contained in the conglomerated rocks along the Connecticut; and they are often so numerous that the rock appears like a real secondary conglomerate. The masses are very firmly fixed in the base, and often there appears a mutual impregnation and sometimes the veins of granite cut through the imbedded fragments, as in Fig. 6.

Thus we have a real conglomerated sienite, and I had almost said a conglomerated granite: for much of the rock containing these fragments is destitute of hornblende, while all the ingredients of granite are present. And the instances in which this conglomerated rock occurs, are not confined to the particular locality above named—but it is to be found in many other parts of the range. I have seen bowlders of it in Surry, Alstead and Walpole in New-Hampshire, but I did not there see the rock in place.

The Northampton sienitic range lies at a very low level. A considerable part of it is hidden by a deposit of sand through which it sometimes projects. The sienite in Belchertown is also rather low. All the remarks above made, in relation to the Northampton range, except that in regard to its conglomerated character, will apply to this. The best route which I have found for viewing this sienite, after cross-

ing it in several places, is to pass by the right hand road from Belchertown congregational meeting-house, to the meeting-house in Ludlow.

The narrow deposit of sienite which is first mentioned above, as occurring in Whately, is somewhat different in its characters. Let the observer proceed northerly on the main road from the congregational meeting house one mile, till he comes to the farm of a Mr. Crafts. On the left hand side of the road he will find a ledge of rocks which are greenstone slate, nearly allied to hornblende slate, and sometimes to chlorite slate. Let him cross these strata westerly, about fifty rods, and he will come to a deposit of decided unstratified primitive greenstone, about twenty rods wide. Immediately succeeding this rock, he will find the sienite above named. It consists of nearly equal proportions of felspar and hornblende, the latter of a dark green and of a distinctly crystalline structure; and the former white and compact or very finely granular, entirely destitute of a foliated structure, or pearly lustre. These ingredients seem to be promiscuously blended, and the rock appears to be peculiarly well adapted for being wrought and polished for useful and ornamental purposes. The bed is not very extensive, only about six rods wide at the place above mentioned, and I have never been able to trace it more than one or two miles. It is separated from the mica slate by a narrow stratum of greenstone slate.

Sienite, or sienitic granite, occurs in many other places along the Connecticut; but in no other place have I found it extensive enough to deserve a place on the map, except perhaps in Chatham, and with the relative situation of this I am not sufficiently well acquainted. Where I have crossed it, it appeared to form a bed in porphyritic hornblende slate.

8. PRIMITIVE GREENSTONE.—*Cleaveland.*

Colored Carmine or Rose Red, and marked by parallel lines crossing each other.

This is one of Werner's varieties of primitive trap. If it be asked what that is, I should suppose Mr. Maclure's supposition to be not an improbable one, that "what Werner calls primitive trap may perhaps be compact hornblende; or per-

haps the newest floetz trap when it happens to cover the primitive." (*Journal of Sci.* Vol. 1. p. 212.) Yet there are two circumstances in regard to the rock here denominated primitive greenstone, along the Connecticut, which have led me to doubt its exact identity with our newest floetz trap, or secondary greenstone. 1. The primitive greenstone is never amygdaloidal; while a great part of the secondary is so. 2. The primitive greenstone not merely covers other rocks, but forms beds in them. An example of this may be seen one mile east of the Milford marble quarry on what is called the old road leading to New-Haven; where the greenstone lies between strata of a rich intermediate, between greenstone slate and mica slate, and the rocks have every appearance of being contemporaneous.

Primitive greenstone is colored in the following places on the map, viz. at West-Haven and Milford—at Wolcott—at Whately, in the western part of Northfield and north part of Gill. In regard to that in Wolcott, or the Eastern part of Waterbury, I know but little, it being several years since I observed it, and some snow being on the ground at the time. I put it down merely for the sake of pointing out its locality.

The most extensive deposit of the rock is at West Haven and Milford; on both sides, but especially on the east side, of the Verd Antique stratum. The hummocks of it that appear very frequently, but irregularly, very much resemble the detached hills of secondary greenstone, except that they are less elevated and the blocks of debris are usually larger. A little south of the Derby turnpike, this is the first rock that shows itself as we ascend from the alluvial plain of New-Haven on the Humphreysville turnpike also, there is but a narrow stratum of chlorite slate separating it from the alluvion.

This greenstone often becomes stratified on both sides of the ridge, forming greenstone slate. At first, we perceive a partial and interrupted stratification; and in a few feet it becomes decided, extending through the whole mass. There is also frequently seen a double stratification; one set of planes crossing the other rectangularly or obliquely. Well characterized greenstone slate, however, is not abundant in Milford or West Haven. It usually soon passes into chloritic slate, or even into a bastard mica slate. An account of

these slates has been long since given to the public by Prof. Silliman in President Dwight's Statistical account of New-Haven, page 11. Their strata run N. E. and S. W. and dip to the S. E. The angle of depression below the horizon rarely exceeding 30° or 40° .

Let hand specimens of this primitive greenstone and of the secondary greenstone from East or West Rock be exhibited to a geologist who had never visited the localities, and he would not hesitate, I think, to pronounce that from East and West Rock to be primitive, and the other to be secondary; and for the reason, that he would find the secondary greenstone to be much the coarsest and most crystalline. The primitive greenstone of this locality is finely granular, and agrees, in this respect, with Jameson's description of transition greenstone. Indeed, it has already been suggested (Journal of Science, Vol. 2. p. 165.) that the Verd Antique of Milford *may possibly* belong to a transition series; and if so, this greenstone, greenstone slate, and chlorite slate, and even that bastard mica slate which is sometimes found between this marble and the secondary, may belong to the same class. The finely granular texture of transition greenstone, is however, by no means a distinctive character: since both the primitive and floetz greenstones are described as possessing the same.

The range of primitive greenstone in Northfield and Gill, commences about two miles north of the northern termination of secondary greenstone, and extends into Vernon. Its characters are very similar to those of the same rock at Whately and Milford. Some of it however approaches rather nearer the nature of sienite: but still the hornblende predominates. It is often stratified and often semi-stratified, becoming greenstone slate. Near the southern point I observed a vein or dike of limpid quartz several rods long and one foot wide, traversing this rock, having, a part of the distance, *saulbandes* of felspar.

The primitive greenstone occurring in Whately is somewhat different in its characters from that in Milford. It is coarse and usually highly crystalline in its texture, being sometimes rendered almost porphyritic by the imbedded peices of compact felspar, and sometimes being little else than pure hornblende. It is not extensive and alternates in one instance with sienite, the locality of which has been pointed out in treating of the latter rock.

The greatest part of this greenstone is greenstone slate, the strata having the same direction as that at Milford, and being nearly perpendicular to the horizon, bearing a few degrees one way or the other occasionally. This slate is also more crystalline than the same rock at New-Haven. It is however a less degree of crystallization that chiefly distinguishes it from hornblende slate, towards which it verges and into which it probably passes. Notwithstanding the very decidedly fissile character of this slate, I have noticed in some instances a tendency in it to the trappose form; some of the specimens having a cleavage, like many crystals, in two directions, one coinciding with the direction of the strata and the other running across the strata. The proportion of felspar in this rock is small, often almost imperceptible. Chlorite, however, abounds as in the greenstone slate of Milford; and often it becomes real chlorite slate. Seams and beds of quartz are common in the Whately rock and also granular epidote.

Some of the rock colored, as hornblende slate in Shelburne, &c. much resembles certain varieties of this greenstone slate; and were the two rocks contiguous, it would be difficult to draw the line between them. Indeed, by some, this Whately rock would probably be denominated hornblende slate: but I think there is a distinction between the two rocks; and so long as any of the stratified rocks of Milford retain the name of greenstone slate, it would seem the Whately rock, from its resemblance and similar associations with unstratified primitive greenstone, demands the same appellation. An observer will be struck with the resemblance of the greenstone strata at these two places, and with their similar situation in regard to mica slate; and he will be disposed to enquire whether these rocks were not once continuous between these two places;—and in the intermediate space, he will find sufficient evidence in the great quantity of mingled detritus of other rocks, that the higher strata have suffered much from some levelling agent in former days.

9. ARGILLITE.

Colored Brick Red.

The remarks last made in regard to the primitive greenstone, chlorite slate, &c. will apply to this rock. For we find it near the two terminations of the secondary tract and on the same side of it—viz. in Woodbridge at the south end, and commencing on the north at Leyden and extending at least as far as Rockingham, Vermont. The northern deposit is much the most extensive and is best characterized. In both places, however, it is often tortuous and slightly undulating, especially when passing into mica slate. It embraces numerous beds and “tuberculous masses” of white quartz—perhaps the milky quartz. The passage into mica slate is usually very gradual, the characters of the argillite losing themselves by imperceptible changes in those of the mica slate, so that for a considerable distance, the observer may be in doubt to which rock to refer the aggregate. The Woodbridge argillite occasionally alternates with mica slate, (*Journal Sci.* Vol. 2. p. 203.) and I have ascertained that this is the case also with that of Vermont. That which is just beginning to pass into mica slate, alternates also with a peculiar coarse limestone to be described under the next article; or rather, the limestone forms beds in the argillite—for instance in Putney.

A principal object in extending the map so much beyond the secondary region on the north, was to include all the argillite to be found along the Connecticut. Whether I have effected this object I am not certain. The Rev. E. D. Andrews, who communicated to me several facts on this subject, is of opinion that the northern limit of the argillite is on the south side of Williams’ river in Rockingham, three miles north of Bellows Falls; but he had not examined the regions beyond with sufficient care to decide the point with certainty.

In Guilford, Vermont, this argillite alternates with a peculiar rock which Professor Dewey remarks appears “to be a talco-argillite with much quartz.” Its stratification is less perfect than the argillite; or, rather, it has more of the irregularities and tortuosities of mica slate. Its small extent

and imperfect characters prevented my putting it down as a distinct rock. The stage road from Greenfield to Brattleborough passes over it in the southern part of Guilford. At the same place occurs well characterized chlorite slate; but not constituting any extensive range.

One mile south of this spot, another rock occurs, which an observer, at first sight, would pronounce to be granite. It is unstratified* and has the color of granite; but seems to be made up chiefly of quartz with a little mica interspersed. It seems to be an aggregate to which no particular name has as yet been applied; although the proportion of mica is so small that it might almost be called quartz simply. It appears to form a large bed in argillite, or talco-argillite.

The strata of argillite, both in Connecticut and Vermont, run in a direction nearly N. E. and S. W. and are highly inclined, generally varying but little from perpendicular. They are undoubtedly primitive—that is, the evidence of this is as great as in regard to the mica slate; both being highly inclined, and destitute of organic remains. Indeed, Bakewell, who has transferred argillite to the transition class, says “mica slate has a near affinity to clay slate; and as I have arranged the latter with rocks of the second class, it may perhaps be doubted whether mica slate should not also have been transferred to the same class.” (Geology p. 83.) Do we not here see to what temptations the system maker is exposed, when pressed with difficulties? However, as Professor Kidd remarks,

*“By stratification we understand the divisions of a mass of rocks into many parallel portions whose length and breadth greatly exceed their thickness.”

North-American Rev. No. 29, p. 232.

“Where a rock is stratified, is it necessarily bounded by parallel surfaces? If so, let us hear no more of mantle-shaped, saddle-shaped, basin-shaped, trough-shaped stratification.”

Greenough's Geology, Essay 1.

I would beg liberty to enquire, whether some of these difficulties might not be removed by defining stratification to be the division of a mass of rock into many parallel or concentric portions? But after all, this, like a thousand other definitions in natural history, is only an approximation to the truth: For if mathematical exactness be essential, we have never yet seen any rock whose divisions were either parallel or concentric. Bakewell's distinction (Geology p. 31.) between “the structure which is caused by chemical agency, or by crystallization, and mechanical depositions,” would perhaps give relief to some of the difficulties in regard to stratification, were geologists agreed what rocks have a structure caused by chemical agency and what ones are mechanical depositories. But they are not agreed on this point, as is evident from the very example he brings to illustrate his principle, when he says, that the division of slate rocks into layers, is the result of their chemical composition.

it seems "the terms primitive and transition are daily becoming of less importance."

Quarries have been opened in the Woodbridge argillite and it is employed in New-Haven for building. In Vermont also, they have been wrought in Guilford, and Vernon, two also in Dummerston, S. E. of the centre of the town, two in Putney, one and a half miles north of the meeting-house, and one in Rockingham, a mile north of Bellows Falls. In most of these the slate is of a good quality and easily obtained; but at present they are not much wrought on account of the little demand for it, and consequent low price.

10. LIMESTONE.

Granular Limestone, Eaton, Index, &c.

Colored with India Ink.

This rock, in the country covered by the map, always exists in beds in mica slate and argillite: never occupying, however, so much as half the surface. I have colored it in that region where it occurs most abundantly, that is, in the mica slate nearest the argillite and the sandstone; although its beds exist in nearly all the mica slate north of Northampton on the west side of the river. It is remarkably uniform in its appearance. Its exterior, when it has long been exposed to the weather, is of a dark brown color, showing more marks of decomposition than any other rock in this region. The carbonate of lime is usually worn away at least an inch deep on the surface, and the silex and mica are left in coarse grains, or warts, or in projecting ridges. When newly broken the mica is uniformly of a light gray, and the texture is coarsely granular and dull, except the glimmering of scales of mica. The constituents of the rock are carbonate of lime, mica and silex, in somewhat variable proportions. In a specimen sent to Prof. Dewey, he found about fifty per cent of carbonate of lime and fifty of silex and mica. He judged that the silex constituted about thirty five per cent and the mica fifteen: and he judiciously adds, "the mica is in so great proportion, you cannot call it silicious limestone. At least, ought it not to be called a granitic aggregate, or silicious limestone mixed with mica?"

The beds of this rock vary in width from a few inches to 20 feet, and they rarely exceed this. They are unstratified, are sometimes traversed by veins of quartz, or more frequently granite, and sometimes the rock becomes so mixed with the mica slate, as to form one of its constituent parts. Rhombic crystals of carbonate of lime, of a yellowish brown color, and agreeing by goniometrical admeasurement with the primitive form, are found imbedded in this limestone, and sometimes these are connected with irregular masses of quartz, and larger plates of mica. It forms, when blasted, a good stone for underpinning. I have never seen it along the Connecticut, except in the mica slate at the northwest part of the map—none in any part of New-England, nor in any mineralogical cabinet,—yet it seemed to deserve a place on the map, and a description.

11. VERD ANTIQUE.—*Cleaveland.*

Ophicalce Veinée. Brongniart.

Colored blue, and marked with oblique parallel lines.

The rich and elegant marble obtained from this rock has induced me to give it a place on the map, although its extent is very limited. It extends northerly from Milford harbour, 9 or 10 miles, apparently terminating two miles west of Yale College. It constitutes an extensive bed in chlorite slate, with which it sometimes alternates. I am inclined, however, to the opinion, that the slate lying immediately contiguous to the Verd Antique, although not well characterised, approaches nearest to greenstone slate. Yet, decided chlorite slate, appears usually only a few rods distant. In some places, the Verd Antique is a quarter of a mile in width, and forms ledges of considerable elevation and extent. It is stratified—the layers being thick and parallel to the slate rock enclosing it. The grain is fine; the rock is traversed by veins of calcareous spar, magnesian carbonate of lime, and asbestos; and is associated with chromate of iron and magnetic oxide of iron, diffused, more or less, through the entire body of the marble, and forming dark spots and clouds. The serpentine is twisted and entangled in the limestone in almost every form, and the green color of the rock may in gene-

ral be imputed to oxid of chrome—sometimes to the presence of serpentine, colored however, probably by the same oxid.

This rock has been extensively quarried in two places, one in Milford, 7 miles from New-Haven, and the other only $2\frac{1}{2}$ miles from the city. From these are obtained a marble which vies for elegance with any in the world. Indeed, in the extensive collection of marbles and porphyries in Col. Gibbs' cabinet in Yale College, we appeal to those who have seen them, whether any specimens exceed, or even equal in beauty and richness the Verd Antique from Milford. The varied clouding and shading of the gray, or blue ground of this marble with white, black, green, orange and gold yellow, indeed, with varieties of almost every color of the prism, give it an elegance that can be realized only by those who examine it. The working of this marble is difficult and expensive, and it is earnestly hoped that the patrician part of our community will not, by resorting to Europe for marbles, which, to say the least, are no more elegant than this, compel the proprietors of these quarries to abandon the undertaking. Specimens of this marble may be seen in most of the dwellings of the wealthy citizens of New-Haven; and many of the monuments in the grave yard of that city, are of the Verd Antique. Several chimney pieces of it may be seen in the Capitol at Washington.

Most of these facts in relation to this rock, I derive from the published accounts of it by Professor Silliman. (See Cleaveland's Mineralogy under Gran. Limestone, Marble, and Verd Antique, 2d Edit. Also, Journal Sci. vol. 2, p. 165.) A minute account of this interesting formation is still wanting; and Mr. Silliman has promised it. (See Jour. Sci. vol. 2, p. 166.)

12. OLD RED SANDSTONE. *Werner. Cleaveland.*

It is agreed I believe among Geologists who have examined this region, that an extensive deposit of this rock exists along the Connecticut. (See Cleaveland's Mineralogy, 2d Edit. p. 759. Eaton's Index 2d Edit. p. 207. Tour between Hartford and Quebec, p. 21, and MacLure's Geology of the United States.) It is probably the oldest secondary rock in this region, and generally lies beneath all

the rest. So that it does not, I apprehend, occupy so much of the surface, as is generally supposed. There is much slaty sandstone, red and gray, and some of it very argillaceous, found along this river, which does not appear to be the old red sandstone of Werner; but to be a different formation, which I have denominated the Coal Formation; and which others have called gray wacke slate. I know of no instance in which I am certain that decided old red sandstone lies above the coal formation; although they evidently pass into one another. This coal formation, with the secondary greenstone and alluvion, occupies, I should judge, nearly two thirds of the secondary tract along the Connecticut; leaving not more than one third for the old red sandstone. This rock occupies the greatest extent of surface, as the map will show, in the vicinity of New-Haven. Along the western side of the secondary, it may be found all the distance, (occasionally covered by alluvion,) from New-Haven to Bernardston, Mass. Yet, it forms but few ridges or peaks of much altitude until we come to the south part of Deerfield. There it rises abruptly from an alluvial plain in the form of the frustrum of a cone, five hundred feet above the Connecticut; and the peak is called Sugar Loaf; being but a few rods in diameter at the top, and forming a striking feature in the scenery of the country. This is the commencement of a range, which, five miles north, rises 700 feet above the adjoining plain, and then slopes to the north, almost disappearing in Greenfield; but rising again in the northern part of the town and sending off one or two spurs into Gill.

The grain, even of the finest variety of this sandstone, may be called coarse. Its colour is dark reddish, sometimes presenting spots or veins, of light gray, as in Hatfield, Mass. Its cement is argillo-ferruginous, and the rock usually exhales an argillaceous odour when breathed upon. It contains a large quantity of light gray mica, the plates being sometimes half an inch, or more, across, and inserted promiscuously. This description applies to the finest varieties of old red sandstone. But this passes into and alternates with conglomerates of the same general character and of various degrees of coarseness. The imbedded pebbles, vary in size from that of a musket ball to four or five inches in diameter. They are usually quartz, felspar, graphic

and common granite, and rarely gneiss or mica slate. The coloring matter of the rock, in most instances, has penetrated through these pebbles, giving the granitic nodules the same color as the rock, and the quartz a bluish aspect. This conglomerate frequently alternates with the sandstone, and one half of the layer of a rock is sometimes sandstone, and the other half conglomerate, no fissure being between them. Generally speaking, however, the puddingstone increases in quantity and coarseness as we ascend a mountain of this rock, and all the upper part of the hill is sometimes composed of it. Probably more than one half of the old red sandstone in the northern part of the range is this conglomerate: yet, as it is evidently a mere variety of the sandstone, it was thought altogether unnecessary to attempt a division by different colors on the map.

A considerable part of the range of this rock colored on the east side of Connecticut river, is somewhat different in its appearance from that I have been describing on the other side. At least, there is one very abundant variety that is not found on the west side. It consists of a fine, siliceous, red sand, adhering together with but very little visible cement. It has, however, an argillaceous odour. The coherence is not as strong as in the coarser sandstone, it being slightly friable. This rock may be seen in place in the southwest corner of Ludlow, and the east part of Long Meadow, Enfield, Somers, Ellington, &c.; and it forms a neater and handsomer building stone than any other rock of the sandstone family which I have ever seen.

A part of this range of red sandstone, east of Connecticut river, appears also to be verging towards the sandstone constituting the coal formation. Examples of this may be seen at the extensive quarry in Chatham, and also in Middletown—there seems to be a gradual passage of one rock into the other—and the strata of both these rocks have their dip in such a direction, as to lead one, at first, to conclude that this old red sandstone lies *above* the coal formation. The dip of both rocks is to the east. It does not follow, however, from this circumstance, alone, that the red sandstone does in fact repose on the other rocks. Thus, let A B be a profile crossing the valley of the Connecticut, and exhibiting the strata of old red sandstone, having

a dip as represented by the parallel lines. Let C D be a deposite of the coal formation lying upon the old red sandstone, the strata of which have the same dip. Now, to an observer passing along the surface from A to D, the red sandstone, between A and C, appears to lie upon the coal formation between C and D, whereas, the reverse is the fact. This might apply to the rocks we are considering in Connecticut, were it not for what I think to be the fact, that there is a gradual passage of the old red sandstone into the coal formation.



These, and some other circumstances, made me suspicious, for a time, that this range of sandstone east of Connecticut river, might not be the real old red sandstone, but a member of the coal formation;—and it was not till I had traversed it the third time, that I felt entirely satisfied. But much of it certainly does not differ, at all as I could discern, from the old red sandstone on the western side of the river; and we find likewise the very same conglomerate. The strata also, are of a similar thickness and dip, varying as to the form, from six inches to two or three feet; and as to the latter from 10° to 30° ; usually, however, not more than 10° . This dip, in all the red sandstone of the Connecticut, is below the eastern part of the horizon, with the single exception of a ledge that appears in the west street of Hatfield, where the dip is to the west.

This rock is extensively quarried for the purpose of building, in almost every town along the river. Noble specimens may be seen in the vestibules of the churches in New-Haven.

Organic Remains.

These are very rare in our old red sandstone. I found, however, in Deerfield mountain, one or two specimens that belong to the *petrifacta* of Martin; there being a perfect substitution of a finer grained sandstone for the original substance. I found only fragments, about four or five inches long, and they appear to belong to the genus *phytolite* of Gmelin's Linnaean System, and to the species *lignite*. They are a third of an inch in diameter, and a little flattened; and seem to agree with Professor Eaton's description of certain petrifications found in red sandstone on the Catskill Mountain; (Index p. 211.) which he is inclined to refer "to the tribe of naked Vermes."

Fossil Bones.

These occur in East Windsor, east parish, one hundred rods south of Ketch's Mills. They belong to the *conservata* of Martin, and, without much doubt, to the genus *zoolithus* of Gmelin. The animal must have been about five feet in length, and lay horizontally in the rock, eighteen feet below its top, and twenty-three below the surface of the ground. The tail bone, as Dr. Porter, who lives near the spot, informed me, projected beyond the general mass containing the body of the skeleton, about eighteen inches in a curvilinear direction. This, of which that gentleman gave me a specimen, was easily distinguished by its numerous articulations. On exposure to the air, the bones begin to crumble and lose the appearance they presented when first dug up.

The rock in which these bones were found, is decidedly the old red sandstone. It agrees exactly with that rock as it exists at New-Haven, and to the distance of one hundred miles north from that town. The rock enclosing the bones is a little coarser than the finest varieties of this rock, and in the rock above the bones, was found some moderately coarse conglomerate. Whatever doubt I had with regard to some other varieties of rock in that vicinity, being the real old red sandstone, I could have no doubt in regard to this, after examining it.

13. SECONDARY GREENSTONE. *Cleaveland.**Colored Carmine, or Rose Red.*

To give the ranges of this rock, was one of the principal objects in constructing the accompanying map. For although it be an anomalous, it is a highly interesting formation. The high mural precipices that almost universally show their naked faces in the ridges and hillocks of this rock—the immense quantity of *débris* that frequently slope up half, or two thirds the distance to their summits—and the thin tufts of trees that crown their tops, form much of the peculiar scenery of the Connecticut. They remind the European of the basaltic and other trap ridges of Scotland, Ireland, Saxony, Auvergne, Italy, &c.

In regard to the greenstone* north of Hartford, I feel confident that every range of it to be found in place, is inserted on the map. South of Hartford some small and low hillocks of it may have been overlooked, notwithstanding all the assistance I have received from Prof. Silliman and Dr. Percival. For, in some places, this rock seems to be but a few feet in thickness above the sandstones, and to be less continuous than in the northern part of the map. In East-Haven and Branford especially, there are so many ridges of greenstone, and these so irregular, that it is difficult, on a map of such a scale, to make them all distinct and accurate.†

The most southerly point of greenstone on the map is the bluff in East-Haven, which fronts Long Island Sound, and is about one mile and an half north of the Light-House. The most northerly points of this rock are in Gill and in Northfield. The greenstone which occurs in the upper part of Northfield, is more crystalline and of a coarser texture than in the intermediate distance, and is undoubtedly

* To save room, I shall omit, in the remainder of this article, the term secondary, as applied at the head of the article.

† There ought to be a geological map of the region about New-Haven, on a larger scale than the one I have given : and we could name more than one gentleman in that city, who is amply qualified for its construction.

primitive greenstone. Some of the specimens scarcely differ from pure hornblende.

Between the two extremities of granite above named, there is not a mile, except in Amherst, where this rock may not be found in some part of the valley of the Connecticut. The most continuous and lofty ridge is that of which West-Rock may be considered as the southern termination—although the west rock range is broken off a few miles between Mount Carmel and the Meriden or Berlin mountains. This ridge from West-Rock to Cheshire, presses hard upon the primitive rocks, often approaching the slate within a few rods. It presents, on the west, a lofty naked wall, appearing as if nature had erected this mighty rampart to guard the secondary region of the Connecticut from the encroachments of the primitive; while the great quantity of broken fragments along its base and scattered in abundance for four or five miles over the chlorite slate and argillite, evince that these ridges of greenstone were once much more elevated than at present. This range divides in the northern part of Hamden, the eastern branch forming Mount Carmel, and the western branch continuing into Southington, where it chiefly disappears, although immense bowlders of greenstone are scattered over the surface until we come to the north part of Farmington. Here the ridge again commences, and inclining considerably to the right, terminates in the north-east corner of Granby, Connecticut, in the Menitick or Manitick mountain, on the top of which runs the line between Granby and Suffield.

Mount Carmel terminates a little east of north from New-Haven, and until we reach the Meriden or Berlin mountains, the greenstone disappears. Commencing with these mountains, we find an almost uninterrupted ridge of greenstone, continuing into Massachusetts. Its elevation decreases, for the most part, as we go north, until we come to East-Hampton, when it suddenly rises, like the coil of a huge serpent, and forms Mount Tom, probably the highest point in the greenstone ranges of New-England. I do not know that its height has ever been accurately measured: but, comparing it with Holyoke, it cannot be much less than a thousand feet above Connecticut river. Connecticut river crosses

this range at the north end of Mount Tom, and on the opposite bank it rises again precipitously and forms Mount Holyoke. This I found, with a nice sextant, to be eight hundred and thirty feet above Connecticut river. North of Holyoke the greenstone is curved towards the right and continues of nearly the same elevation until it terminates near the north-west corner of Belchertown, having reached the primitive region.

Nine or ten miles north-westerly from this point, we find a narrow ridge of greenstone commencing, and pursuing a course considerably west of north, it passes through Sunderland, crosses Connecticut river, runs through Deerfield, crosses Deerfield river, and extending through a part of Greenfield, terminates at the falls in Connecticut river. A few rods east of this termination another range commences and runs east of north through Gill, with some interruptions, till it reaches its extreme northern point in Northfield, two miles south of the primitive greenstone.

It will be seen by the map, that these greenstone ridges separate the old red sandstone from the coal formation nearly the whole distance from Berlin to Northfield; and the rocks of the coal formation are frequently found lying *above* the greenstone. The range of green stone in Sunderland is very narrow, and being in an unfrequented spot along the western margin of Mount Toby, it was a long time before I discovered its existence. Having once found it, however, it was traced, without much difficulty, except what an almost impassable precipice presented. It is from ten to eighty rods wide. As you ascend the mountain from the west, you first pass over a formation of old red sandstone, which is here a coarse pudding-stone. Next you come upon the greenstone, most of which is amygdaloidal, and is, so far as hand specimens will enable us to decide, the real toad stone of Derbyshire. Immediately east of the greenstone you find the coarse, brownish red, and the fine, fissile, argillaceous, gray and red sandstone slates of the coal formation. These uniformly rise in higher ledges than the greenstone; even one hundred or one hundred and fifty feet above it. As you pass along in the direction of the greenstone ridge, these precipices are not more than ten feet from you on one hand, and the greenstone at no

greater distance on the other. The broken fragments of the two rocks are confusedly mingled together, the sandstone breaking into large tables, and the greenstone into pieces only a few inches across. These huge tables are covered and fringed with a great variety of cryptogamous plants, such as various species of *Pamelia*, *Juggermannia*, *Sticta*, *Collema*, *Bartramia*, *Hypnum*, *Polypodium*, *Aspidium*, *Asplenium*, &c.; most of which are evergreen. And if the geologist be also a lover of this department of botany, he will find the wild and confused blending of such a variety of interesting objects to repay him amply for the labor and even danger of clambering over the fragments. I have never seen any rocks that seemed so congenial to the growth of cryptogamous plants as those constituting Mount Toby.

But to return from this digression. As the observer follows this greenstone southerly, commencing at its northern extremity on the banks of Connecticut river, and sees the lofty precipices of sandstone overhanging it, little doubt will remain in his mind that the greenstone actually passes under the sandstone. Yet any one acquainted with the anomalies of trap rocks will have the question arising in his mind, may not this greenstone, after all, here constitute an extensive dike? and he will hardly be satisfied until he sees the actual contact of the two rocks in place. One mile north-east of Sunderland meeting-house, the greater part of the greenstone ridge disappears and seems to run under the sandstone; but here a few feet of *débris* hide the actual junction. A little farther south an actual junction is seen; but the huge table of sandstone resting on the trap is removed a few feet from its original position. And, indeed, I never knew expectation so frequently disappointed, just at the moment when it seemed about to be realized, as in examining this range. It seems as if nature intended here to teach the geologist a lesson of patience. But, at length, one mile and a half south-east of Sunderland meeting-house, the observer comes to a valley worn by a brook, where finding the greenstone, which thus far has preserved almost a right line, widening towards the east, and forming a reentering angle in the sandstone, the angular point being in the brook; he will have little doubt that

the greenstone is here disclosed by the abrasion of the superincumbent sandstone—and on following the line of junction a few rods on the south side of the brook, he will find the sandstone in place lying directly on the greenstone, also in place. To one who has been accustomed to see this latter rock mounting above every other and monopolizing so much space for its broken fragments, it must be gratifying to see it at last pressed down by a superior stratum, and buried by the debris of a higher rock. In two places south of the point above described, other brooks have worn away the sandstone, and the greenstone forms in it a like reentering angle ; but the actual contact of the rocks is hidden.

But Sunderland is not, after all, the best spot for observing the rocks of the coal formation lying above the greenstone. I have been thus particular in describing the range of greenstone in that place, rather to exhibit the difficulties and trials to which the geologist is subject in examining the trap ranges of the Connecticut, than because it was necessary for this particular purpose.

Let the observer follow the Sunderland greenstone ridge northerly across Connecticut river into Deerfield, and he will here find it widening and increasing in altitude, presenting a mural precipice on the west, and a gradual slope on the east. Where it crosses Deerfield river it has every appearance of a vast dyke : although the sandstone rocks do not appear immediately in contact with it. From the top of the greenstone to the bottom of the river is more than two hundred feet. The range continues to the falls in Gill, where, as before observed, it terminates, and is succeeded by the red sandstone or conglomerate. And here would I mention another fact in regard to the greenstone and rocks of the coal formation. The latter do not merely lie above the former, but *they alternate with one another*. Let the observer pass round the northern termination of the greenstone range first mentioned, and follow down a small river called Fall river, to its mouth, and just at this point he will see the fine-grained, red, fissile, argillaceous sandstone of the coal formation, mounting up fifty feet upon the back of the greenstone at an angle of forty-five degrees. And if he follow down the west bank of the Connecticut

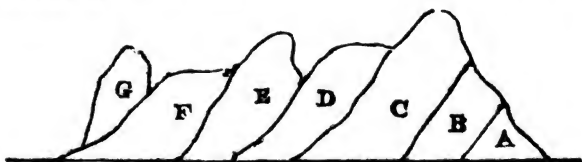
two miles, he will have repeated opportunities of observing the same fact; the river having worn away the rocks so as to afford a fine chance for observation. Let him now return and cross the mouth of Fall river eastward, following up the north bank of the Connecticut, and he will find the same red slate, cropping out about fifteen rods, when he will come to another ridge of greenstone, *under which* the slate passes. If he follows the junction of the rocks obliquely up the hill, on the east side of Fall river, a hundred rods in a northeasterly direction, he will observe the greenstone lying upon the slate more distinctly. Let him return to the bank of the Connecticut, where the sandstone slate passes under the greenstone, and he will observe them both extending in the same manner into the stream. If he now go eastward along the bank of the river, he will find greenstone twenty rods, and then the same or nearly the same slate, rising on the back of the greenstone at an angle of forty-five degrees. Thus will he have conclusive evidence of the alternation of these rocks. This alternation, crossing this same spot, is represented in the profile accompanying the map. No. 8 is the first ridge of greenstone above mentioned: No. 9 the sandstone slate, rising on its back: No. 10 the second ridge of greenstone; and No. 11 the second stratum of the slate. This second ridge of greenstone, as already marked, extends northeasterly into Gill and terminates in the west part of Northfield.

Another spot for observing the alternations of greenstone and the coal formation is one hundred rods south-east of Lyman's tavern, on the north-east side of Mount Tom, in Northampton. A small stream here crosses the road, and in its bed and banks several distinct beds of greenstone, some of them not more than one or two inches thick, may be observed at low water.

In the southern part of that extensive greenstone ridge extending from Amherst to Meriden, the sandstone of the coal formation may often be seen on the west side of the greenstone, lying underneath it. The shaft of the copper mine at Newgate prison passes through the greenstone and enters the sandstone: and Dr. Percival informs us (*Jour. Sci.* Vol. 5, p. 42,) that in Southington, "sometimes the sandstone can be very distinctly seen cropping out below the greenstone on the west side of the ridges." At the

outlet of Salstonstall's pond in East-Haven, I have observed a grey micaceous sandstone of the coal formation, passing under the greenstone with a considerable dip; and also two miles south of Durham village, on the side of the turnpike leading to New-Haven.

Dr. Percival, who has examined most of the greenstone ranges in Connecticut on foot, illustrates his views of the relative position of this rock and the coal formation as follows—referring particularly to the vicinity of Berlin. As you ascend the mountain ridges from the west, the lowest rock you find, after leaving the alluvion, is the old red sandstone, represented below by A. Above this lie the argillaceous sandstones of the coal formation, represented by B. The cap of the ridge C is greenstone; precipitous on the west side, but gently sloping on the east. Passing on we come to another stratum of the coal formation; as D. Next, perhaps, succeeds another ridge of greenstone, E—similar to C; and on its back, we find again the coal formation, F; And sometimes the cap of greenstone is insulated, as G.



Sometimes we find the greenstone resting immediately upon the old red sandstone, without the intervention of a third rock; as at East and West Rock near New-Haven.

From all that I have seen and learned concerning these rocks, I feel therefore, warranted in concluding, that, as a general fact, our greenstone alternates with, or forms beds in, the peculiar rocks of the coal formation; and it seems very probable that both these repose upon the old red sandstone. As the slates of the coal formation dip below the eastern horizon, it would seem we are furnished with the reason why the mural faces of the greenstone are almost universally on the western side of the ranges.

When greenstone rests on the coal formation, the lower part of the greenstone seems to consist of little else than a greyish black, indurated, ferruginous clay. Perhaps even

wacke* may be found lying between the greenstone and the sandstone, as at Gallows-Hill near Hartford, and on the west side of the Berlin ranges of greenstone. Some of the greenstone occurring in the dykes of this rock in old red sandstone, has a similar aspect. At the junction of the coal formation and greenstone below the falls in Gill, the columnar tendency of the latter rock entirely disappears, and for several feet, the greenstone is distinctly, though somewhat irregularly, stratified; the strata being parallel to the sandstone. This may be seen to most advantage at very low water; and the same may be seen, though less distinctly, along the whole eastern border of this range of greenstone; and something of it on the east side of all the greenstone ranges along the Connecticut. It ought here to be remarked, also, that this rock appears quite different in its composition on the eastern side, especially of the range passing through Deerfield and Greenfield. The indurated clay seems in a great measure to take the place of the hornblende, and the basis of the rock has a wacke-like appearance. Much of it is amygdaloidal; but the imbedded minerals are usually quite different. On the east side, the most abundant is chlorite, having a radiated aspect, and green earth; whereas, on the west side, this is scarcely to be found. The radiated zeolite on the west side is finely fibrous; on the east side, the crystals are larger and transparent, resembling the Thomsonite of Dumbarton in Scotland. The rock on the eastern side is, also, more decomposable than on the opposite side.

The eastern side of this rock is not, however, all amygdaloidal. Near where Deerfield river passes through the range, on the north bank, this rock contains distinct crystals, or rather plates of felspar; and thus becomes a porphyritic greenstone. "It even approaches to ophites," says Professor Dewey. The same rock contains good prehnite, and in the prehnite may be found pyritous copper.

I should judge that about one half of the greenstone of the Connecticut constitutes the base of amygdaloid, and very much of it appears to be genuine toadstone. The cavities are usually spheroidal or almond shaped, sometimes reniform, and frequently cylindric. Those of the latter

*I have recently found *wacke* perfectly well characterised, and very abundant, at the foot of the very lofty mural precipices, two miles north of Monte Video, on the Talcot mountain, ten miles W. of Hartford.—*Editor*.

form are often a foot or more in length, and arranged parallel to one another; the rock appearing as if bored through repeatedly by an augur. The imbedded minerals are calcareous spar, analcime, chlorite, quartz, chalcedony, chabasie, zeolite, and Professor Silliman has recently discovered gypsum* in a specimen sent him from Dr. Cooley; a new fact we believe in Geology, and one which renders it not improbable that this valuable mineral may be found in abundance along the Connecticut.

This amygdaloidal greenstone is probably most abundant at the lower part of the greenstone ridges; while the upper part is solid and usually columnar. Frequently, however, the columns are amygdaloidal to their top, and sometimes, as in Deerfield, in passing in the direction of the ridge, you will find alternate successions of amygdaloidal and solid greenstone columns. On breaking into the interior of the former, we often find them a rich reservoir of rare minerals. The cavities are usually small; but sometimes several inches in diameter, occupied by quartz and amethystine geodes, or chalcedony, or agates, or a peculiar pseudomorphous quartz to be described when we come to treat of particular minerals. The largest and best agates occur usually among the greenstone that is not much amygdaloidal, sometimes occupying a cavity, part of which is in one column and part in another. They are very frequent, and some of those recently discovered by Dr. D. Cooley, in Deerfield, are probably the finest yet found in this country. A particular account of them will be given in the proper place. Prehnite sometimes forms a thin incrustation on the columns that are not amygdaloidal; and between the joints of those that are so, is sometimes interposed a thin coating of various minerals, among which epidote frequently predominates.

Some of the amygdaloid is very vesicular, bearing some resemblance to the slag of an iron furnace or lava. The cavities, in certain rare varieties, are various in form; and the base is whitish brown, reddish, and even brick red; containing, in the cavities, much prehnite, and this mineral, together with calcareous spar, seems, in some instances, to be mixed with the greenstone to form the base. An enthusiastic Huttonian would doubtless be gratified to find

*This gypsum was perfectly fresh—crystalized—white, and retaining its water of crystalization.—*Editor.*

such a variety. A locality of it may be found one hundred rods north of the Deerfield river bridge in Deerfield, at the western foot of the trap range.

The columnar tendency of our greenstone has often been noticed. It may be seen in almost every ridge in a greater or less degree, on the mural face—and these columns are sometimes remarkably regular. Good examples of them occur on the south-west face of Mount Holyoke; and still better ones a mile east of the village of Deerfield, a quarter of a mile north of the locality of chabasie, analcime, &c. mentioned in the *Jour. of Science* Vol. I. p. 115. They have from three to six sides, are articulated, the points varying from one to three feet in diameter, and of the same height, exhibiting handsome convexities and corresponding concavities. Half a mile south of this spot may be seen columns curving to the right and left as they ascend; thus forming a portion of an arch. The geologist, who traverses this ridge, can hardly avoid traversing in imagination the giant's causeway, Staffa and the Hebrides.

Some of the less perfect columns have a remarkably fissile tendency; forming good hand specimens of pseudo-green-stone slate. Globular distinct concretions of this rock are not unfrequent among the amygdaloid; composed of concentric coats of greater specific gravity than the rest of the rock. I have noticed them in Deerfield, and on the New-Haven turnpike between Durham and Northford, they are abundant, and from two to twelve inches in diameter.

The general aspect of our greenstone, where it has been long exposed to the weather, is reddish brown. When newly broken it is greenish, often somewhat lively. Sometimes it is greyish black, and, very rarely, has the color of a brick that has been burnt very hard. This variety is compact and the felspar imperceptible. It is often the fact, indeed, that the two ingredients in other varieties, are not to be discovered by the naked eye, or with an ordinary lens.

A question then occurs, whether some of the varieties of this rock are not genuine basalt? Certainly some of them answer the description of that rock, so far as external characters are concerned, to say the least, as well as of greenstone. And, indeed, if "greenstone and basalt may not unfrequently be seen passing into each other in the same stone, as D'Aubuisson and Dolomieu have observed," (*Bakewell's Geology*, p. 119,) there seems no rea-

son to doubt that this fact may exist in this country as well as in Europe. Were I to refer to particular localities for rocks resembling basalt, I should mention the foot of Mount Tom on the north-east side, and a part of the range passing through Deerfield. It would not surprise me, should future geologists make a division of our greenstone, calling a part of it basalt; dividing the upper part of the ridges from the lower, or the eastern side from the western, or both. A geologist, to be able satisfactorily to make these divisions, or to decide whether any of our rock is basalt, ought to have traversed extensively and observed minutely the like rocks in Europe; and, therefore, I leave the subject to abler hands.

A good locality for observing many of the varieties of greenstone above described within a narrow compass, is on the north bank of Deerfield river, about sixty rods from the bridge. Let a person cross the bridge to the north, and take the right hand road, until he comes to where the road passes round the end of the greenstone ridge. Here he will first see the most common variety, having a columnar tendency; and a few rods beyond, the reddish brown variety,* and in a wall, supporting the road on the right hand, he will find abundance of the porphyritic greenstone, having a somewhat stratified structure. Here, too, he will find some specimens covered with a ferruginous coating; so much charged with iron, indeed, that efforts have been made to smelt it. Indeed, a mass of four or five pounds from almost any part of this greenstone range, when held by the side of a compass, will move the needle.

It is not always the case, nor even generally, that the greenstone ridges that are marked as continuous on the map, are strictly so. They are often composed of numerous peaks or ridges, partially detached, but yet constituting a single range when viewed at their bases. And sometimes, when there appears to an observer passing along the western side of the range to be an uninterrupted wall, closer examination will show, that it is made up of several distinct ridges, so lapping on upon each other, and so near one another, that they appear continuous. The mural face of the ridges and hillocks is usually on their western side: but sometimes on the opposite side, as in the high moun-

*I have a specimen of greenstone from a vein in Scotland resembling this, except that the Scottish rock is much coarser.

tain between Durham and Northford; and sometimes on both sides, as Menitick mountain in Granby, Ct. Mount Carmel in Hamden, and Mount Tom in East-Hampton, at its southern extremity. The broken fragments of the greenstone, of almost every shape, seldom of any regular figure, and of various sizes, usually slope up more than half the distance from the bottom to the top of the ledge. This débris is highly interesting to the chronologist, because it furnishes him with a decisive

Cosmogonical Chronometer.

Every one who lives in the vicinity of these greenstone ridges knows, that every year adds to the loose masses at their base, at the expense of the columns above. The water infiltrated through the thin soil on their tops, finds its way into the narrow seams between the columns, and there freezes in the winter, and by its expansion, removes the rock a little from its place. This operation is repeated, year after year, and thus some part of the rock is pushed so far over the precipice that its center of gravity falls without the base, and it comes thundering down, usually dividing into very many pieces. Sometimes, if the foot of a column gives way in this manner, the whole column above, perhaps twenty or thirty feet long, is precipitated, like a glacier, on the loose rocks below. Sometimes only one or two of the lower joints fall out, leaving the principal part of the column suspended, the shuddering observer can hardly tell by what. He will also see evidences in very many places, both in the ledge above him and in the ruins beneath them, of recent instances of this kind. Indeed, in almost any place along these mural points, two or three of the outer columns are easily removed by the application of a lever, being loosened by the ice of preceding winters.*

Now every one must see that this levelling work cannot have been going on forever; and when we consider how

*On tearing down some of these columns a few years since, during the winter, in search of chabasie, &c. I found the spaces between them occupied by an immense swarm of the common *mosquito*. Poor insects! it was all over with them as soon as the avalanche thundered. The Hon. Elihu Hoyt informs me he found a swarm of these creatures in the winter, in a hollow tree.

very considerable is the quantity of rock yearly detached, and compare this with the whole amount of the débris, the conclusion forces itself upon us that the period when this process began could not have been vastly remote ; in other words, that the earth has not existed in its present form from eternity. Its precise age cannot, indeed, be determined by this chronometer ; but I have often thought that, judging from this alone, we should be led to conclude that Moses placed the date of the creation too far back, rather than not far enough.

Greenstone Dykes in Old Red Sandstone.

Professor Silliman conducted me to an interesting locality of these in East-Haven. They occur on the main road from New-Haven to East-Haven, less than half a mile from Tomlinson's bridge. We measured their width, and that of the intervening sandstone, as they appear on the northeasterly side of the road. The road here passes over a small eminence, and the bank, on the north side, in its highest part, is almost fifteen or twenty feet above the road. The dykes, occurring at this place, are exhibited on the profile accompanying the map ; and are laid down from a scale of fifty feet to an inch, with the intervening sandstone. In describing them I shall begin at the north western extremity, that is, at the point nearest New-Haven : but a person wishing to find them, will do best to go first to the other end of the profile ; because the dikes are there more distinct.

No. 1. (See Profile.) Old red sandstone, coarse and containing pebbles so as to form a conglomerate. The dip of the strata is from 6° to 10° below the eastern horizon. The sandstone is very similar throughout.

No. 2. Greenstone dike, 4 feet thick.

No. 3. Sandstone, 114 feet. This distance was measured by pacing ; the other distance by a rule.

No. 4. Greenstone, one foot thick.

No. 5. Sandstone, 9 feet.

No. 6. Greenstone, 9 feet.

No. 7. Sandstone, 40 feet.

No. 8. Greenstone, 10 feet. The soil has so covered this spot, and we having nothing with which to penetrate it, we did not actually see the dike. But the walls are distinct,

having small peices of the greenstone attached to them, and exhibiting somewhat of an altered appearance, like the other walls, so that little doubt could remain of this being a genuine dike.

No. 9. Sandstone, 52 feet.

No. 10. Greenstone, 5 feet.

No. 11. Sandstone, 45 feet.

No. 12. Greenstone, 10 feet.

No. 13. Sandstone, 19 feet.

No. 14. Greenstone, 7 feet.

No. 15. Sandstone, 7 feet.

No. 16. Greenstone, 4 feet. Here the greenstone is hid by the soil as is also the sandstone at the other end of the profile: so that by removing this, probably other dikes might be discovered.

Thus we have eight dikes in a distance of 21 rods. Some of them require a little attention to discover them; but most of them are very distinct. Some of them we traced several rods on both sides of the road, in a direction perpendicular to the profile. Their width is sometimes suddenly decreased, or increased, several inches, so as to form shoulders. They are not exactly perpendicular, but lean a few degrees to the west; and thus they are made to form an angle considerably obtuse on their eastern side with the sandstone. The latter rock is often somewhat glazed, having a specular aspect at the place of junction with the greenstone, and the two rocks are not unfrequently mutually impregnated, for several inches, with each other's properties.

I did not notice that the dikes at this place dislocate the strata of sandstone: but I paid little attention to this point.

Several dikes, similar to the above, (three at least,) occur in the old red sandstone on the right hand side of the turnpike from New-Haven to Middletown, on the east margin of the salt marsh lying east of East Rock. One of these is remarkably distinct, cutting through a precipice twenty or thirty feet high, and maintaining an uniform width of about a foot. This crosses the strata nearly at right angles; but makes an angle with the horizon of about 45° dipping to the south west. On its roof, or upper side, near the lower extremity, a part of the sandstone strata are thrown upwards two or three feet; and they are affected laterally about the

same distance. The dike along with the sandstone appears to pass under a hill of greenstone.

On the same turnpike, a few rods north-easterly of Northford meeting-house, four or five dikes occur; but they are so hidden by the soil as not to be particularly instructive. In passing from Durham to New-Haven on the same road, the first low ridge of greenstone, which we cross, exhibits something, which I was almost disposed to denominate a dike of coarse pudding stone, of the coal formation, in greenstone. Certainly, there appears a peculiar juxtaposition of the two rocks; but probably they exist in beds.

Two or three miles north of the dikes of which a profile is given, Dr. Percival found several others; and perhaps they are a continuation of the same. He found one also on the road from Farmington to Hartford in the rocks of the coal formation.

The greenstone found in these dikes has usually the dark compact aspect of basalt—resembling, however, much of the greenstone found along the Connecticut. Yet it seems to want the characteristics of greenstone, and specimens which I collected from the most perfect dike above described, half a mile east of East Rock, even approach to wacke. This rock gives an argillaceous odour, is of a greenish grey color, has an uneven fracture, is dull, and much softer than common greenstone; so that it may be cut with a knife:—and on comparison with a specimen of pure wacke from Calton Hill, (Edinburgh,) which was analyzed by Dr. Webster, it does not appear to differ, except in its greater hardness and perhaps less softness to the touch. I have little doubt that these dikes will ere long be denominated basaltic dikes: but, for the reason formerly alleged, I forbear to name them thus. They are an interesting feature in our geology, and deserve more attention; and it is peculiarly fortunate that they should be situated so near a geological school and the first mineral cabinet in our country.

Juxtaposition of Secondary Greenstone and Primitive Rocks.

The actual contact of these has never been observed along the Connecticut; and I know of but three places where there is a probability of finding the junction—viz. in the northeast part of Belchertown, in East-Haven and Bran-

ford, and in the east part of Woodbridge. So far as I have examined these places, I have always found a valley of geest between the rocks. But this is often very narrow; as for example half a mile west of Bransford meeting-house, where granitic ledges lie on one side of the road and a greenstone ridge on the other. Further examination of this and the other points mentioned above, might discover associations similar to those occurring in the Hebrides.

Origin of Greenstone.

Does the greenstone of the Connecticut afford evidence in favour of the Wernerian or of the Huttonian theory of its origin? Averse as I feel to taking a side in this controversy, I cannot but say, that the man who maintains, in its length and breadth, the original hypothesis of Werner in regard to the aqueous deposition of trap, will find it for his interest, if he wishes to keep clear of doubts, not to follow the example of D'Aubuisson, by going forth to examine the greenstone of this region, lest, like that geologist, he should be compelled, not only to abandon his theory, but to write a book against it. Indeed, when surveying particular portions of this rock, I have sometimes thought Bakewell did not much exaggerate when he said in regard to Werner's hypothesis, that, "it is hardly possible for the human mind to invent a system more repugnant to existing facts."

On the other hand, the Huttonian would doubtless have his heart gladdened, and his faith strengthened by a survey of the greater part of this rock. As he looked at the dikes in the old red sandstone, he would almost see the melted rock forcing its way through the fissures; and when he came to the amygdaloidal, especially to that variety which resembles lava, he might even be tempted to apply his thermometer to it, in the suspicion that it was not yet quite cool. And without doubt he would see many a volcanic crater on the top of these ranges, where, with our dull eyes, we see only a pond or a quagmire. Even the occurrence of this greenstone in beds in sandstone would present no obstacle, since the discoveries by Dr. Macculloch in the isle of Skye of similar beds, of whin stone; concerning which he says, "there are no instances but where the alternating beds of trap detach veins or dikes from the lower to the upper beds;

of the trap, quitting the interval between two given beds of limestone or sandstone, makes its way across the one immediately above or below, and then proceeds with a regularity as great between some other pair of proximate strata"* (*Transac. Geol. Soc. Vols. 3 and 4.*)

By treating the subject in this manner I mean no disrespect to any of the distinguished men who have adopted either side of this question. To President Coope especially, who regards the greenstone of the Connecticut as volcanic, I feel much indebted for the great mass of facts he has collected on the subject. And were I to adopt any hypothesis in regard to the origin of our greenstone, it would be one not much different from his. But I confess myself somewhat given to scepticism in regard to any general geological system extant; and Greenough on the *First Principles of Geology* has not aided much to remove my doubts. These systems have been productive of great good by spurring forward geologists to the collection of facts with a rapidity almost unequalled in any other science. When these shall be still farther accumulated, it is hoped and may be expected, that a second Werner will arise, who, having not merely the rocks of Germany but of the whole world before him, and following the inductive method of Bacon, will be able to construct a system of geognosy that will stand, like the Newtonian system of gravitation, on a foundation too firm to be moved. Perhaps such a system, after all, will prove to be an amalgamation of the theories of Werner and Hutton, and those names, which now form the watch words of opposing ranks, may descend to posterity, engraven side by side, in harmonious union, on the column that supports the system. If geological enquiries are not tending to this point we are much mistaken.

President Cooper was led from the profile inserted in the first Vol. of the *Journal of Science*, page 105, to conclude, the Deerfield greenstone to be a dike disrupting the old red sandstone. No distinction is there made between the sandstone of the east and west range; but since I have ascertained that on the one side is old red sandstone and on the oth-

*It is by no means improbable that similar connecting dikes may be found between the green-stone beds along the Connecticut. In all the places where I have examined these beds, circumstances were unfavourable for discovering the dikes had they existed.

er a sandstone of the coal formation, this greenstone must be regarded as a bed between them.*

14. COAL FORMATION.

Variety of Psammite. Brongniart.

Grey Wacke Slate. Eaton.

Colored brown by Umber.

It has long been known to mineralogists that coal was found along the Connecticut; and I denominate the rocks containing it the coal formation, simply because its beds occur in them, and in no other rock; the old red sandstone containing none at all, but lying *below* it. The coal formation embraces numerous varieties and sub-varieties of rocks, most of which alternate with one another and the principal of which are the following. 1. *Greenstone*. This strictly belongs to this class because it alternates with the other varieties and in Berlin contains coal. But there were sufficient reasons for giving it a separate color and description, which it is unnecessary here to mention. 2. *Trap, Tuff.* (*Trap Breccia*, Cleaveland.) This occurs on the east side of Mount Tom on the west bank of Connecticut river, and appears to lie between other rocks of the coal formation and the greenstone, and perhaps alternates with the greenstone; though I cannot say much as to its geological relations, as I have but recently discovered the rock and have had little opportunity to examine it. It consists of rounded or angular fragments of greenstone, quartz and sandstone, united by a reddish brown abundant cement of comminuted and decomposed sandstone, greenstone or wacke. Scales of mica appear scattered in the rock which seem to have belonged to the sandstone. It exhales an argillaceous odour, is difficult to break, and is about of the hardness of old red sandstone. The imbedded masses of greenstone are larger than the quartz or sandstone. I noticed some, six, eight, and even twelve inches across. Perhaps this rock is not the real trap tuff of Europe. If not, it certainly deserves the name of *greenstone conglomerate*: although many of the imbedded masses and

* Some other corrections needed to be made in the essay accompanying that profile and map. But as I intend to comprehend all that is important in that paper in this Sketch, a particular specification of corrections seems unnecessary.

the greenstone in the vicinity very much resemble basalt. The sandstone imbedded is that fine-grained argillaceous variety next to be mentioned. 3. *A red, very fissile, friable, argillaceous sandstone.* It generally contains small scales of mica and is abundant almost every where, frequently lying immediately upon the greenstone and alternating with it and with many other varieties of rock hereafter to be mentioned. 4. *A Gray Micaceous Sandstone Slate,* not argillaceous, grit coarse, very fissile, layers even, some varieties much resembling mica slate, others containing vegetable remains. 5. *A similar slate;* but much finer, harder and the layers undulating. 6. *A slate* approaching in appearance to shale, but very silicious, harder and very fissile, layers straight, surface not smooth, dark gray. 7. *Shale,* generally bituminous, very fissile, frequently micaceous with and without Ichthyolites. 8. *A slaty rock* of the aspect of shale, and sometimes much resembling coal, dividing into numerous small pieces of irregular form, and disintegrating when exposed to the air and moisture. At the falls in Gill. 9. *A slate* made up chiefly of indurated clay, sometimes micaceous, easily scratched by the finger nail, liable to disintegration. Falls in Gill, and cave in Sunderland, not abundant. 10. *A fragmented rock,* the fragments chiefly a reddish brown quartz, appearing as if burnt, cement silicious and apparently ferruginous, rock very hard, and appearing almost like porphyry, unstratified, not abundant. In Gill. 11. *Gray pudding-stone,* distinctly stratified, layers from six inches to a foot thick. Imbedded nodules, quartz, felspar and mica slate, rarely more than an inch in diameter, but very abundant, cement same minerals comminuted. Island in the falls at Gill. 12. *Reddish stratified pudding-stone,* coarser than the last, and scarcely differing from the conglomerate accompanying the old red sandstone. Mount Toby, Belchertown and Granby. 13. *Very coarse dark gray pudding-stone,* scarcely stratified. Imbedded masses often very large, even a foot in diameter, and very abundant, consisting chiefly of mica slate, argillite and chlorite slate; but containing quartz, hornblende, talcose slate, and sometimes granite, cement the same, rocks comminuted. Gill, Montague, Mount Toby, and Durham. Most of the preceding rocks are often found alternating with one another. 14. *A gray imperfect limestone,* very silicious, in beds in sandstone slate, not fetid, not abundant, Gill. 15. *Fetid*

carbonate of lime. At Northford. I do not know its exact relative situation. 16. **Bituminous carbonate of lime*, in the coal formation at Southington and Middletown.

In this series of rocks, and in this only, has coal been found along the Connecticut. It occurs at Durham, Middletown, Chatham, Southington, Berlin, Somers, Ellington, Enfield, South Hadley, and Southampton. In most instances it is highly bituminous and burns freely. The seams of it are usually quite thin, rarely exceeding an inch in thickness, yet often they are numerous. In Berlin, the coal occurs in greenstone in a vein of crystallized quartz. (Journal of Science, Vol. 5, p. 44.) In Southington it is found in shale—in Somers, Ellington and Suffield, in friable argillaceous slate, (No. 3 above) in Enfield, in beds in gray micaceous sandstone; (No. 4. above) also in the same rock, ("granulated schistose aggregate" of Eaton, vide Journal of Science, Vol. 1. p. 136,) in the drift of the S. Hampton lead mine.

The Connecticut river, in its passage between the towns of Gill and Montague, has cut through the coal formation, except a single ridge of greenstone on the west, as may be seen by referring to the map. Through a considerable part of this distance, especially in the most interesting part, the bassetting of the strata is completely laid bare; and I have annexed to the map a profile of their order and dip, which I shall now proceed to describe. It is a vertical section, crossing the map at the falls in Gill and the strata nearly at right angles, extending on the west to the western part of Shelburne, so as to include a few other rocks beside the coal formation, and on the east, to the mouth of Miller's river. The chief object of this profile is to give a better idea of the coal formation than could be obtained by mere verbal description. That part of it, therefore embracing those rocks, is put down from a larger scale than the other parts, otherwise the numerous alternations could not have been represented. Especially that part between No. 8 and 40, is laid down from a larger scale than the rest of the coal formation, because this is the most interesting part of it and most distinctly laid bare on the north bank of the Connecticut, extending from the falls to the high greenstone ridge 100 rods west of it. This part was observed most attentively, and a quadrant converted into a clinometer, was used for determining the

* Bituminous marl slate?—Ed.

dip. The distances were all estimated by the eye, but it is presumed they will in general be found not far from the truth. From No. 1 to 56, inclusive, the stratified rocks all dip to the east, as is evident from the section. The Nos. included in parenthesis, refer to the general descriptions of the rocks of the coal formation in the beginning of the article.

No. 1. *Hornblende Slate*—Strata highly inclined, often becoming an aggregate of hornblende, quartz and mica, having a porphyritic aspect.

No. 2. *Mica Slate*—Dip 20° to 30° , undulating and tortuous, passing on the east into argillite.

No. 3. *Limestone*—In beds in mica slate, already described in the preceding pages. Unstratified.

No. 4. *Argillite*—Dip 60° to 90° . The southern limit of this rock hardly reaches the line of the section: but a mile or two north, its relative position is as represented on the profile.

No. 5. *Old Red Sandstone*—With red conglomerate. Dip usually as much as 20° , being greater than is usual for this rock.

No. 6. *Alluvion*—A swamp.

No. 7. *Old Red Sandstone*—Dip between 20° and 30° .

No. 8. *Secondary Greenstone*—It is probable this forms a bed between the old red sandstone and the coal formation: but the former rock is never seen passing under it in this vicinity; and, therefore, it must not be thus represented on the profile. Width about half a mile. On the eastern side it has, for a few feet in width, somewhat of a stratified structure.

No. 9. *Red, Fissile, Friable, Argillaceous, Sandstone, Slate*—(No. 3.) It is fine grained and often micaceous, of the color of brick, is easily cut by a knife, yields an argillaceous odour, has an undulating surface generally, and is liable to disintegration. This is probably the most abundant of the rocks of the coal formation; and it usually lies next to the greenstone and alternates with it. It is found over a large extent of country on the east side of the greenstone ridge, stretching from Amherst to Berlin; although in Connecticut it more frequently is wanting in the mica and its surface is more uneven. It forms much of the flagging stone in Hartford and exists in place a foot or two below the surface in that city; though it seems here in some instances to approach to the nature of shale. The surface of the layers often appears a little glazed and is sometimes traversed by numerous little ridges, a mere line in thickness and of the

substance of the rock, which I have sometimes suspected might be petrifications; and perhaps they are so. When this rock is disintegrated it forms an admirable material for the construction of roads; a good example of which may be seen in the road between Hartford and Weathersfield.

Where the profile crosses this rock, it has a dip of 45° ; and as already observed under the article greenstone, it here mounts upon the back of the greenstone forty or fifty feet. If we follow the junction of these rocks southerly, on the west bank of the Connecticut, we shall find *the slate conforming to the irregularities of the greenstone*, thus forming saddle shaped strata. In some instances we notice a sudden curve from this cause, of 90° . At the first copper mine we find on passing down the river, a narrow spur of the greenstone extends a short distance into the slate, and the vein of ore here passes from the greenstone into slate. Half a mile south of this point we find the slate crossed obliquely to the direction of the strata by parallel seams dividing it into strips from one to six inches wide and often five feet long. Sometimes we find in these divisions six sided prisms of quartz, lying partially imbedded and exhibiting both terminations in great perfection. I have seen seams very narrow containing green carbonate of copper, the sides of the vein being beautifully glazed, having a highly specular aspect, and forming the *saalbande* of the Germans. The width of the rock on the section is about fifteen rods, extending across the mouth of Fall river.

No. 10. *Greenstone*—(No. 1.) This has been already described when treating of that rock. Thickness of the formation, 20 rods.

No. 11. Same as No. 9. (No. 3.) Thickness of the stratum, 6 rods, dip 45° .

No. 12. *Red Slate*—resembles the last, but is more micaceous, is divisible into thinner laminæ, the surface of which is even, and the color is less red. A beautiful rock. Thickness 6 feet, dip 45° .

No. 13. *Reddish micaceous sandstone*—Somewhat conglomerated, the imbedded pebbles of quartz and flesh colored felspar, small and rounded, less fissile than the last, layers thicker. Thickness twelve feet, dip 40° .

No. 14. Same as No. 12. Thickness 15 feet, dip 40° .

No. 15. Same as No. 9. Thickness 15 rods, dip 40° .

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No. 16. *Reddish gray, friable, argillaceous sandstone slate*—Irregular, tortuous, disintegrating at the surface, a little micaceous, containing numerous small specks of carbonate of copper, and appearing to be an imperfect copper ore. Thickness 4 feet, dip 40°

No. 17. *Hard, compact limestone*—(No. 14.) Fracture dull, containing a large proportion of silex, feebly effervescing with the acids. Thickness of the stratum only a foot, dip 48°, not divisible into layers. This very imperfect and small bed of limestone is the only locality of limestone rock I have ever found in the secondary region north of Hartford.

No. 18. *Gray, Micaceous sandstone slate*—(No. 5.) Irregular, tortuous and undulating, not as easily and as handsomely separating into layers as the red slate, resembling some varieties of the mica slate, scarcely argillaceous. Thickness 6 feet, dip 40°.

No. 19. Same as No. 9. Thickness 12 rods, dip, 43°.

No. 20. *Coarse, reddish conglomerated sandstone*—Containing imbedded pebbles. Scarcely different from No. 13, except somewhat coarser. Thickness 6 feet, dip 43°.

No. 21. Same as No. 12. Thickness 3 rods, dip 43°.

No. 22. *Gray, micaceous, sandstone slate*—Rough to the touch, coarse, granular, scarcely argillaceous, not separating into so thin layers as the red slates. Surface not undulating or tortuous. Thickness 15 feet, dip 43°. An excellent flagging stone.

No. 23. (No. 9.) *Soft argillaceous slate*—Surface smooth, scarcely undulating, divisible into thin plates, easily scratched by the finger nail, and consisting of little else than clay moderately indurated. Thickness 5 feet, dip 45°, easily disintegrated, rarely micaceous.

No. 24. *Gray micaceous sandstone slate*—Similar to No. 22, but softer to the touch and finer grained, more undulating and divisible into thinner layers, containing vegetable remains converted into perfect coal. These were so numerous in one spot, that I thought I had found a bed of coal. Thickness 3 rods, dip 40°.

No. 25. *Geest*—2 rods.

No. 26. *Shale*—Color very dark, containing sometimes small scales of mica, surface a little knobby, containing abundance of sulphuret of iron and spheroidal nodules from half an inch to two inches diameter, of *argillaceous iron ore*?

very similar to the shale containing the ichthyolite at Sunderland. Thickness 1 rod, dip 40°.

No. 27. Same as No. 24. 2 feet thick, dip 40°.

No. 28. A stratum of coarse grayish sandstone, or rather conglomerate, 2 feet wide, dip 40°.

No. 29. Same as No. 24. Thickness 5 rods, dip 40°.

No. 30. *Geest*—10 feet. It may be well, perhaps, here to remark, that shale usually forms the roof and floor of coal beds, and that this *geest* and that of No. 25 lie immediately below shale. Connect this fact with another, "that the seams or strata of coal rise up to the superficies of the globe as well as all other strata, only they do not always push up so boldly to the very surface of the ground as many hard stones and other indurated strata are found to do; for on account of the tender and more friable texture of the coal, the superficies of the stratum is often mouldered down and lies concealed under a thicker or thinner bed or cover of clay, gravel, sand, or earth." (Williams Mineral Kingdom, Vol. 1. p. 135 2d edition.) If then coal can be found along the section here described, (which I suspect to be quite doubtful,) the best spots to search for it are Nos. 25 and 30.

No. 31. *Shale*—10 feet thick, dip 40°, containing abundance of nodules of *argillaceous iron ore*? Rock rather hard for pure shale, not liable to much disintegration.

No. 32. *Coarse, gray, sandstone or conglomerate*—Rock harsh to the touch, imbedded masses not large, layers thick. Thickness two rods, dip 40°.

No. 33. Same as No. 24. Thickness 3 rods, dip 43°.

No. 34. *Shale*—Alternating with, and passing into, a bluish, gray, fine grained slate, harder than the shale, though perhaps only a variety of it. A little micaceous. Thickness 3 rods, dip 43°.

No. 34. *Blackish gray slate*—Similar to that mentioned under the last No. but less fissile and much harder, indeed, it breaks with nearly as much difficulty as greenstone, and where it is worn by the water it somewhat resembles that rock. For it contains numerous irregular cells, sometimes two inches in diameter, formerly filled, probably with *argillaceous iron ore*? On breaking the rock its structure is slaty and it is a little micaceous. Thickness 2 feet, dip 40°.

No. 36. *Coarse grayish sandstone or conglomerate*—like No. 32, layers 2 feet thick. Thickness 20 feet, dip 40°.

No. 37. *Red slate*—As No. 9, but harder and coarser and less irregular on the surface of the layers. Thickness 3 rods. dip 40°.

No. 38. Same as No. 22. Thickness 20 feet, dip 40°.

No. 39. Similar to No. 38, but more micaceous and divisible, into thinner layers; resembles much, certain varieties of mica slate, except that the siliceous has a more earthy aspect. But it would not be difficult to deceive almost any geologist by labelling hand specimens, mica slate. Thickness 2 feet, dip 40°.

No. 40. Same as No. 37. Thickness 10 feet, dip 40°. This carries us to the dam across the Connecticut.

No. 41. *Hard gray sandstone slate*—Like No. 22, but more undulating and irregular. Thickness 5 rods, the remaining distance the scale is much reduced.

No. 42. Very near No. 41, but coarser and not so undulating. Thickness 8 rods.

No. 43. *Coarse gray conglomerated sandstone*—layers thick. Thickness 12 rods.

No. 44. Same as No. 40. 3 rods thick, dip 35°.

No. 45. *Alluvion*—20 rods.

No. 46. Same as No. 32, about 2 rods thick.

No. 47. Same as No. 40, 1 rod thick.

No. 48. *Alluvion*—a quarter of a mile; beyond this the section is continued on the south bank of the river.

No. 49. Same as No. 37, one half a mile.

No. 50. (No. 10.) *A singular fragmented rock*—unstratified, 20 feet thick, very hard and tough, imbedded fragments, chiefly reddish brown quartz, appearing as if it had undergone the action of fire, a little micaceous, cement often blackish, appearing like veins, apparently ferruginous, rock resembling some varieties of porphyry.

No. 51. (No. 6.) *Dark gray, very fissile sandstone slate*—Harder than shale, somewhat argillaceous in its odour, a little micaceous, surface rough and grit coarse, slightly sonorous when struck, 1 rod thick, dip 40°.

No. 52. Same as No. 50, 1 rod thick.

No. 53. Similar to No. 39, 5 rods thick.

No. 54. *Alluvion* between half and three quarters of a mile.

No. 55. Same as No. 9, half a mile.

No. 56. Same as No. 51, extending nearly a mile, dip at first 35° , but gradually decreasing to 15° . The direction of the strata of this rock is quite different from the other varieties, which generally have a direction between north and northeast. But this variety is so much wheeled that it runs not far from east and west; and in passing up the river we sail for a time nearly parallel to the direction of the strata. I do not see why this rock might not be employed for roofing; and if so, the situation of the quarries would surely be very advantageous.

No. 57. Same as No. 9, strata nearly perpendicular, but leaning a little to the east, and their direction nearly the same as that of all the varieties mentioned except the last. Thickness 10 rods.

No. 58. (No. 8.) *Blackish tortuous slate*—Stratification irregular and the layers dividing into numerous shapeless pieces by fissures in every direction. The surface of these amorphous pieces is frequently a little glazed. Rock, friable, scarcely micaceous, argillaceous, strata leaning a few degrees to the east, 20 rods thick. This rock forms a bed at the island in the falls in the Connecticut three miles below this spot, and there it is exposed to the occasional action of the water and is disintegrated so as to leave the superincumbent strata projecting over it several feet, and it very much resembles impure coal: but I could not determine that it contains any. It is probably a variety of shale.

No. 59. *Very coarse, dark gray puddingstone*—A general description of this rock has already been given in the beginning of this article. (No. 13.) Imperfectly stratified at this place, rather harder than the old red sandstone conglomerate, yet appearing as if composed of little else than a mass of pebbles, the cement being not abundant, extending at least a quarter of a mile. The Connecticut at this place has worn a passage between this rock and the primitive, and high ledges appear on both sides of the river, which, on comparison, seem to differ almost *toto coelo*. The puddingstone extends through Montague, sometimes assuming a reddish aspect, and in Sunderland forms a considerable part of Mount Toby. Here it alternates with the red and gray slates above described; and it is curious to observe the frequent sudden changes from this coarsest of conglomerates to fine grained slates.

Where the profile crosses this rock, some of the imbedded masses appear at their surface as if they had undergone the action of fire. On breaking a mass of gray quartz containing a little mica, a zone of half an inch wide appeared at the outer edge, of a brick colour, indicating a chemical change either by fire or water, for the specimen was sometimes covered by water.

I have observed little of this peculiar puddingstone in Connecticut, though so abundant in the northern part of the coal formation. It appears, however, in the south part of Durham.

No. 60. *Gceest*—covering a narrow valley.

No. 61. A narrow stratum of gneiss.

No. 62. *Granite*—This does not appear in abundance on the bank of the river. The best spot for examining it is half a mile south, where it forms a hill 100 or 200 feet high.

From the preceding description of this profile, it appears, that after crossing the first ridge of greenstone there is a gradual decrease of the dip from 45° to 15° , and after passing this point, which is not exactly central, but nearer the granite than the greenstone, we find the dip in a *contrary direction*, and almost 90° . Precisely such would be the effect, the Huttonian would say, if we suppose the granite and the greenstone to have been forced up through the strata by a subterranean fire, after these strata were consolidated. And we might expect, also, that this convulsion would produce that wheeling of the strata observed in the central parts. There is something peculiarly striking in this explanation, and an inquiry arises, whether any corresponding facts occur in any other part of the coal formation. At mount Toby, a few miles south of Gill and the highest point of the coal formation, the strata dip to the east at an angle usually less than 10° . And here the greenstone ridge on the west is small, but the granite on the east, at no great distance, is abundant. On the south east side of Mount Holyoke in Belchertown and Granby, the strata dip to the south east, near the mountain, at an angle not less than 45° , and the greenstone ridge here is large. But the rocks that lie on the back of Mount Tom, the highest point of greenstone along the Connecticut, have a dip not generally larger than 20° . And the same remark will apply to many greenstone ridges on the accompanying coal formation in Connecticut.

The highest point of the coal formation is Mount Toby in Sunderland, which rises between eight and nine hundred feet above the Connecticut. Beginning at Whitmore's ferry, the locality of the ichthyolites, to be hereafter described, and passing up the mountain obliquely to the south-east, we find alternations of most of the rocks described in the above profile. The different varieties of conglomerate are most abundant, and cannot, except that variety which is reddish, be easily confounded with the conglomerate accompanying the old red sandstone. They differ from this latter rock, 1. By being of a light or dark grey color, sometimes a little red. 2. In the greater abundance of imbedded nodules, and less quantity of cement. 3. In the different nature of these nodules, those in the old red sandstone conglomerate being chiefly quartz, felspar and granite, and those in the coal formation pudding-stone, being chiefly mica slate, argillite, chlorite slate, talcose slate, and quartz with felspar and granite rarely. 4. The coal formation pudding stone often contains thin incrustations of carbonate of lime in the seams and crevices. The red sandstone is wanting in this.

As a general fact, I feel prepared to state that the rocks of the coal formation *lie above* the old red sandstone. In most cases these rocks are separated by greenstone, so that their exact situation cannot be easily ascertained. Along the western face of the greenstone ridge, extending from Meriden into Massachusetts, the rocks of the coal formation are often seen cropping out below the greenstone; and the old red sandstone occurs at a still lower level. This may be seen in the space of a few rods in descending the hill northerly, from Newgate prison; and although the actual junction of the rocks is not here observable, yet they appear only at short distances from one another. The fact, that the coal formation alternates with greenstone, and that this latter rock always lies above the old red sandstone, is a strong presumptive argument that all the coal formation lies above the old red sandstone, and conclusive evidence that a part of these rocks lie above it. The situation of the rocks about Middletown, Chatham, &c. which might be urged as an objection to this fact, has been already considered, and I leave it for further examination.

There are many instances, also, in which the rocks of the coal formation *pass into the old red sandstone*. Let a person go to the mouth of Fall river in Gill, where, as already described, he will find the red argillaceous sandstone slate of the coal formation cropping out below the greenstone. Let him ascend Fall river, and he will find this slate becoming coarser, the layers thicker and the aspect changing, until, within a mile and a half, it becomes decided old red sandstone or conglomerate; the dip, also, diminishing. Or let him follow the road that leads from the mouth of the river to Greenfield, and as he ascends the hill, he will observe a gradation from the slate above named into decided fine grained red sandstone. Much of the rock occurring along the east side of Connecticut river in Somers, Ellington, Chatham, in Middletown and Durham, appears to be intermediate between old red sandstone and this slate of the coal formation. Even in Somers and Ellington, where a strip is marked as coal formation, I found little else but this intermediate rock. But as coal has been found there, (*Am. Journal of Science*, vol. 3, p. 248,) a strip has been colored brown, rather to mark out the locality than the extent, of the coal formation. It is not improbable that some more experienced geologist than myself, may hereafter include the rock I have marked old red sandstone on the east side of Connecticut river as one of the members of the coal formation—but I could not do it without doing violence to my own convictions.

It may be of importance in a geological view to mention the veins of copper ore so frequently found along the Connecticut greenstone ranges. All these veins which I have seen, or of which an account has been published, are found on the margin of the greenstone and coal formation; and *the veins always pass, either laterally or perpendicularly, from one rock into the other*. They are quite numerous, and we have already remarked that copper ore and iron pyrites are not unfrequently disseminated in the slates.

To avoid mistake: I will just mention different spots on the map that are colored as the coal formation. 1. A large extent in Gill, Montague and Sunderland; 2. In Granby, Mass. and Ludlow; 3. A small patch in Somers and Ellington; 4. An extensive range extending from West-Springfield to Berlin; 5. In Hartford, Westfield, Mid-

dletown and Durham; 6. A small patch in East-Haven; 7. A narrow range in Southington; 8. The same in Westfield and South-Hampton. The latter, in the northern part, is penetrated by the drift to the South-Hampton lead-mine; but scarcely appears at the surface. In Westfield, however, it is wider.

It would seem from the preceding description that all the rocks essential to Werner's Independent Coal Formation are to be found along the Connecticut, viz. a friable micaceous sandstone, shale and pudding-stone, (Cleaveland, vol. 2, p. 508,) and also the greenstone and amygdaloid Professor Jameson has added. Still, however, there are some other circumstances which may leave the geologist in doubt whether the real independent coal formation occurs along this river.

Some may suppose the rocks above described to be grey wacke and grey wacke slate; and if the definition of grey wacke be so broad as to include those pudding-stones *whose cement is merely a comminuted portion of the imbedded fragments*, it will indeed include not only the pudding-stone of the coal formation above described, but, for aught I can see, *even the old red sandstone*; and, indeed, what fragmented rock will it not include? And besides, many of the argillaceous sandstone slates described above, cannot, without difficulty be distinguished from certain varieties of grey wacke slate in hand specimens. But the rock usually called grey wacke in Europe has never yet, I believe, been found lying above the old red sandstone, as does the coal formation along this river. It is usually traversed, says Jameson, by quartz in the form of veins, which is rarely, if ever, the case in our rock. It has never been found alternating with beds of any sort of coal, except the coal blende; but our rock contains many beds and veins of that which is highly bituminous. Again, the ichthyolites and other organic relics that are found at Sunderland have almost all the rocks of the coal formation lying above them, as may be seen by the sketch of Mount Toby, that will be given when we come

*Some judicious remarks on this subject are contained in the North-American Review, No. 29, p. 235. There we find the following sentence concerning the Roxbury and Dorchester plumb-pudding-stone, which somewhat resembles a certain variety described above. "This rock forms one vast bed, which we have examined in various parts and feel no hesitation in saying that it is not the grey wacke of European geologists."

to describe these remains. But in other countries "these fossil remains of fishes are found only in strata of very recent origin." (Rees. Cyc. Art. *Ichthyolites*.)

The great dip of many of these rocks may be thought to afford evidence of their being older than the old red sandstone, or the independent coal formation. But to show that the dip of rocks is a very equivocal criterion of their age, I need only to refer to the recent work of Greenough on the first principles of geology. And besides, it is no uncommon thing in real coal fields for rocks to be highly inclined. "This inclination or dip of the (coal) strata is found every where; in some places it varies very little from the level; in others considerably, even so much as to be nearly in a perpendicular direction;" (Rees Cyclopaedia, Art. Coal,) and still farther, as already hinted, there is reason to believe that Mount Toby, the strata of which are almost horizontal, exhibits the original dip of these rocks, and that those cases in which they are more highly inclined are the result of some Plutonian convulsion. Such irregularity in the dip of coal fields is no uncommon occurrence. "In some coal fields," says Mr. Williams, (*Nat. Hist. Min. Kingd.* vol. 1, p. 93,) "the strata acquire this horizontal and waving position, and afterward, towards the south-west or toward the north-east, the declivity becomes again so steep as to form an angle of 45°, and in some particular instances to approach still nearer to the vertical position." Upon the whole, I think there are insuperable objections against referring the rocks of our coal formation to grey wacke and grey wacke slate.

Another opinion already advanced on the subject is more probable. It is that of Mr. Brongniart, who gave it after having seen only the rocks containing the Westfield fish impressions. "This formation," says he, "appears to me to have the strongest resemblance to that of the bituminous marl slates of the copper-mines in the country of Mansfield and Hesse." (*Journal of Science*, vol. 3, p. 220.) The arguments in favor of such an opinion are, 1. The great similarity in the appearance of the German and American rocks on which the fish are found—one species, at least, being the same in both. 2. The occurrences of copper ores, and similar ones too, along with native copper in both rocks. 3. The fact that both these varieties of rocks lie immediately above the old red sandstone. Perhaps there are oth-

er points of resemblance, but I have not been able to find any minute account of the bituminous marlite formation.*

On the other hand it may be said that no real bituminous marlite occurs along the Connecticut—provided the grand distinction between this rock and bituminous shale consists, as Professor Cleaveland says, (Mineral. vol. 1, p. 191,) in its effervescence with acids; for our rock, certainly that at Sunderland, does not effervesce with acid, unless it contains, as it sometimes does, a slight incrustation of carbonate of lime. Mr. B. does not consider the occurrence of thin beds or veins of coal as opposed to his opinion; but the strata penetrated at Riegelsdorf in Hesse, in order to reach the fish impressions, are totally different from those occurring along the Connecticut. They are as follows: “No. 1. Ferruginous clayey mould, from one to two fathoms. No. 2. Greyish white limestone, from six to eight fathoms. No. 3. Blue clay, with imbedded fragments of selenite crystals, from eight to ten fathoms. No. 4. Bluish limestone, called *Rauchwacke*, from eight to nine fathoms. No. 5. Grey compact gypsum, traversed by ferruginous loam, from seven to eight fathoms. No. 6. Black and grey stinkstone, from one to one and an half fathoms. No. 7. Sand, sometimes loose, sometimes cemented, from one to one and an half fathoms. No. 8. A kind of limestone, called *Zechstein*, of a greyish brown color, and soft above towards the sand, but blacker and more compact below; from three and a quarter to three and an half fathoms. No. 9. A black slaty stratum, containing pyrites and forming the roof of the bituminous marl slate, from eighteen to twenty inches. No. 10. Black cupriferous bituminous marl slate, from three to eight inches: this is the principal depository of the ichthyo-

*Extract of a letter from Dr. J. W. Webster:—

“The bituminous marl slate has been one of the most troublesome rocks for years: some have placed it here and some there. From its effervescence with acids we should perhaps more properly put it among the limestones. Again, from the richness of some specimens of it in copper, they would be classed as copper ores—indeed, we know that it is worked for copper. It occurs in the secondary limestone. Its external characters are very little different from those of bituminous shale of the coal formation; but from all I have learned of it, I am pretty well satisfied that it is distinct from and above the rocks of the coal formation. You will note one striking difference between the two—vegetable impressions are abundant in bituminous shale of the coal field; but rare in the B. M. slate—it is more abundant in fresh water remains.”

lites. No. 11. Gneiss like greyish white rock, consisting of small rounded quartz pebbles, and sometimes of copper and mica, cemented by indurated clay. No. 12. Old red sandstone, or the dead rock, being the fundamental rock of these floetz strata." (Rees Cyc. Art. Ichtyolites.)

Under these circumstances I have thought it safe to denominate the peculiar rocks under consideration along the Connecticut, the coal formation. A more complete set of them has been forwarded to Mr. Brongniart, and we wait anxiously for his final opinion. The suspicious circumstances attending them and the occurrence of the coal hitherto discovered in thin beds and veins only, render it very doubtful whether extensive beds of this valuable mineral will ever be found in them. They have been unsuccessfully explored at South-Hadley, Southington and Westfield, Ct. But I would not wish to discourage further search. The decision of the question above discussed, concerning the precise rank they ought to hold in the rock formations of the globe, is one of considerable importance, since it will depend on that decision whether coal or copper or gypsum may be sought after with the greatest prospect of success. They have long been to me a fruitful source of perplexity, and again and again have I returned from traversing them in utter despair of ever determining their real geological relations. To denominate them the coal formation relieves, for a time, most of these difficulties: but that name will cheerfully be resigned whenever a more correct one shall be proposed.

Organic Remains in the Coal Formation.

1. Ichtyolites.

These occur at Westfield, Ct. and at Sunderland, Mass.; and it is said also at some other places, as at West-Springfield; but I have never seen any, except from these two localities. At Westfield they were found in exploring for coal, lying upon bituminous shale. Two species at least were recognized, one of which Mr. Brongniart calls the *Palæthrissum freislebenense* of Blainville. These impressions have been so repeatedly and accurately described by Prof. Silliman in Cleaveland's Mineralogy and the American Jour. of Science, that it is unnecessary to be more particular.

At Sunderland these impressions occur in bituminous shale, which often contains a little mica, and generally a quantity of iron pyrites, disseminated through the rock. They occur at Witmore's ferry in the north part of Sunderland, in the bank of the river. They are found most abundant at the lowest water mark, at which time two men, in less than half a day, dug out for me nearly fifty specimens. Sometimes a layer of semi-crystalline dark colored carbonate of lime, less than one twentieth of an inch thick, lies between the layers of slate. The substance of the fish is usually converted into coal, the thickness of which is rarely more than one tenth of an inch in any part, and the color is black. In some instances, however, the carbonate of lime above mentioned covers the fish, and has taken the place of the matter of the fins and scales and their original light grey color is preserved so perfectly as to resemble a fish just taken out of the water. Some of the specimens appear contorted; in others the form of the fish is wholly lost, the fins and scales and bones, being scattered about promiscuously, as if the fish had perished in violent struggles, or the rock had been disturbed after its imprisonment. Yet, in the same specimen that contains one thus mutilated, another will appear not more than a foot distant which is whole. I have found four or five specimens in which the fishes (both of them distinct,) lie across each other; sometimes a very thin layer of shale, and sometimes none, separating them. I have another specimen, three feet long and fifteen inches wide, containing seven distinct impressions. The shale in which these ichthyolites occur, when rubbed or held in a flame, exhales a strong bituminous odour.*

Among the impressions hitherto obtained, I can easily discover three distinct species that have scales.* Two of these are represented on the accompanying plate; but the third was so much mutilated, that I did not attempt to delineate it. For at the best it is no easy matter to represent them so exactly as to be of use. They are usually a little indistinct on their border, and not unfrequently injured by pyrites.

Fig. 1. represents a species that is rare.

Fig. 2. shows the most common species. There can be no doubt that this differs generically from the last.

*Precisely such a smell is exhaled from the bituminous limestone in Southampton.

*See the end.

Fig. 3. is probably the same as Fig. 2.; but perhaps not. The outline is given because the fins were more distinct than in the specimen from which Fig. 2. was copied.

These are all of the natural size. Concerning their names, feeling altogether incompetent, I do not even attempt to decide. I have not had an opportunity to compare them closely with the Westfield ichthyolites, and do not know whether they coincide.

Another petrification occurs with these fishes, which resembles the common silver eel, (*Muraena anguilla*,) or some other species of the eel tribe. The width varies from half an inch to a whole one, and the length from one to two feet. The substance of the eel (if indeed it be one,) is not converted into coal, but there is a substitution of the shale of a finer grain, except the head, which is coal. No fins appear, except, perhaps, in one instance, a pectoral one. Sometimes, along the centre of the impression, there is a small relief, answering to the place of vertebrae. The course of the impressions is usually serpentine.

The geological situation of these ichthyolites is interesting. The shale containing them passes under Mount Toby, there being a gradual ascent from this spot to the top of the mountain, two miles distant: so that they lie beneath rocks of the coal formation at the depth of nearly nine hundred feet, most of the varieties described on the profile annexed to the map here alternating with one another. The following sketch exhibits a section of the shale of Mount Toby, so far as the geest would admit of examination, on a line passing from the locality of the ichthyolites to the highest point of the mountain. I do not suppose it perfectly accurate, but it is probably sufficiently so to answer the intended purpose, viz. to exhibit the situation of the ichthyolites. The numbers in a parenthesis refer to those on the profile that are synonymous. The dip of these strata rarely exceeds ten degrees, and is usually less.

No. 1. (No. 59.) *Very Coarse dark grey pudding-stone*, for an account of it see the reference to the profile, on plate No. 8. at the end.

No. 2. *Bituminous Shale*. This contains ichthyolites—strata nearly horizontal—dip never exceeding five degrees. Thickness of the stratum, about ten feet.

No. 3. Same as No. 1. except sometimes alternating with

a pudding-stone, less coarse and more distinctly stratified. Thickness, between two and three hundred feet.

No. 4. (No. 9.) *Red fissile argillaceous sandstone slate*, ten feet in perpendicular thickness.

No. 5. Same as No. 1. Thickness ten feet—dip six degrees.

No. 6. Same as No. 4. Thickness four feet.

No. 7. Same as No. 1. except not so coarse, and more distinctly stratified, agreeing nearer with No. 43 of the profile. Thickness fifteen feet.

No. 8. Same as No. 4. two feet thick. Where this rock alternates with the pudding-stone the change is very striking.

No. 9. Same as No. 7. Thickness fifteen feet.

No. 10. Same as No. 4. five feet thick.

No. 11. Same as No. 7. twenty feet thick.

No. 12. Same as No. 4. graduating into the conglomerate—ten feet thick.

No. 13. Like No. 1. sixty feet thick.

No. 14. *Grey argillaceous sandstone slate*, sometimes micaceous. Somewhat like No. 23. of the profile, but coarser—liable to decomposition and containing many water-worn pebbles. Thickness ten feet. This carries us to the Sunderland cave.

No. 15. Same as No. 4. fifteen feet thick.

No. 16. Same as No. 1. about one hundred feet thick.

No. 17. Same as No. 4. except that it is coarser and the layers thicker—about ten feet thick.

No. 18. A pudding-stone not differing essentially from No. 1. but frequently of a reddish cast and more distinctly stratified. This continues with little interruption to the top of the mountain; though the soil hides it in most parts, and there may be other alternations which I did not observe.

2. *A Clam Shell?*

I found a specimen at the cave in Sunderland, imbedded in an argillaceous slate, which resembles the common river clam. There was a perfect substitution of siliceous matter. A single specimen only was found, which was forwarded to Mr. Brongniart, and he will be able doubtless to decide whether it is a petrification or a peculiar water-worn pebble.

3. Vegetable Remains.

These appear to be either the branches or roots of trees, or the relics of culmiferous plants, and therefore may be called *lignites* and *rhizolites*. They are usually converted into a thin vein of coal, similar to the fish. They are commonly broken into pieces from an inch to two feet long, in the manner represented in Fig. 4. Their width varies from a mere line to two inches. They are not jointed—found in abundance at the falls in Gill; also with the ichthyolites at Sunderland. The rock in which they occur at both places is hardly bituminous shale; but a greyish micaceous sandstone. The longest specimen of rhizolite I have seen occurs on the road side, one half mile south of Newgate prison; being not less than seven or eight feet in length.

4. Unknown Relic.

This is represented as well as it could be in Fig. 5. It is difficult to give a perfect idea of the thing, because there is a relief or swelling along the middle. It sometimes resembles the *ament* of the chesnut, (*Castanea americana* Mx.) but still more the vertebrae of a fish. But in no ichthyolite I ever found, did I see any remains of the vertebrae, and it is not probable, therefore, that this belonged to a fish. It is rare—found with the ichthyolites at Sunderland.

15. ALLUVION.

Colored Gamboge Yellow.

By this term I understand those accumulations of gravel, clay, sand, mud and salt, which are post-diluvian, or have probably been deposited since the Noachic deluge by causes at present acting on the globe. Some varieties may be seen along the Connecticut which we shall mention in the probable order in which they were deposited.

1. *The alluvion on the sea-coast.* This is probably the oldest; because the sea would begin its depositions immediately after the deluge, if the situation of any particular place were favorable—even before it had subsided suffi-

ciently for rivers to have found their channels. On the map it embraces the alluvial plain around New-Haven and the salt marshes extending some distance on both sides of the city. The plain of New-Haven is made up of coarse sand with some gravel and an intermixture of broken shells and sea weed. The marshes consist of sand, mud and salt.

The region about New-Haven, embraced by this alluvion, is interesting to the botanist, as he here finds many plants not growing in the interior. Among these, we may mention *Salsoia kali*, *Salicornia herbacea*, *Triglochin maritimum*, *Statice limonium*, *Iva frutescens* of Lin. and *Ammi capillaceum* and *Conyza camphorata* of Muhl. *Limnethis polystachia* and *juncea* of Ph. *L. glabra*, Muhl. *Holcus odoratus*, Mx. and *Limosella subulata*, Ives. Here also, occur the other new species of Prof. Ives, *Gnaphalium decurrens* and *Asclepias lanceolata*, along with *Plantago maritima*, *lanceolata*, and *Virginica* of Lin. *Eriocaulon pellucidum*, Mx. *Cassia chamaecrista* and *Uniola spicata* of Lin. &c. &c. On the beach we find *Fucus nodosus* and *vesiculosus* of Lin.* and adhering to the latter, *Mytilus striatulus*? (Donov. in Rees.) Here also occur *Venus mercenaria*, (common clam) *Ostrea edulis*? (oyster) and one or two species of *Arca* and *Anomia*, with others I do not know.

2. *Gravel*. This usually lies beneath all other alluvial deposits along the Connecticut: though it sometimes alternates with beds of sand. It is arranged in somewhat regular strata. The pebbles rarely exceed two or three inches in diameter.

3. *Clay*. This is a coarse kind, such as is used for making brick; and generally lies above the gravel and beneath the sand and mud, or loam. It probably underlies those extensive sandy plains that occur in Suffield and Windsor, on the West, and in Springfield, Longmeadow, Enfield, East Windsor, and East Hartford, on the east of the Connecticut. In some places the clay appears at the surface, as in Hartford, Windsor, Deerfield, &c.

* On Long-Island, fifty miles east of New-Haven harbor, I found *Sphaerococcus confervoides*, Agardh.

4. *Sand.* This commonly lies the highest of the alluvion, except in some low meadows that are yearly receiving a deposite of a loamy sediment. The region in which sand occurs most abundantly, has just been mentioned. It is sometimes seen in alternating beds with gravel, clay and loam.

5. *Loam and mud.* This is the most recent of our alluvion, and depositions of it are frequently made. The Connecticut indeed, seems, with some exceptions, to have nearly reached its maximum of depositions, rarely flowing over more than a small part of the alluvion along its banks. But its tributaries, such as the Farmington, Westfield, Deerfield, and Chickapee, still continue annually, and often semi-annually, to flood the adjacent meadows, and to leave there an additional soil, from half an inch to six inches deep, and though the agriculturalist has sometimes to lament the destruction of his crops by these inundations, yet without them his fields would soon become comparatively unproductive.

The depth of the alluvion along the Connecticut has never been accurately measured; but I should judge it sometimes to be as great as one hundred and fifty feet: but in general it is much less. It is not unfrequent to find ten or fifteen feet below the surface of the most recent of this alluvion, logs, stumps of trees, leaves, butternuts, walnuts, &c in a partially decaying state, and sometimes we meet with skeletons of the aborigines of the country. But no aurock, mastodon, or megatherium, has yet been discovered to give an interest to this alluvial formation.

I have found a difficulty in some instances in drawing the line between genuine post-deluvian depositions and geest. In some cases there appears to be a mixture. In other cases the rocks are entirely hid by the soil, and yet the predominant characteristic of the soil is derived from the rock underneath it, although there is a mixture of alluvion. The old red sandstone for instance, and the red slate of the coal formation, are very liable to decomposition, and thus a reddish soil is produced, so manifestly composed of the ruins of the rock, that one is able often to determine from the appearance of the soil at the distance of two or three miles the particular rock that lies beneath it. I have not,

however, intended to put down the alluvion in all such cases, but have colored the spot according to the subjacent rock. And on this ground I am sensible that there are a number of small parts of the alluvion that ought, in strictness, to have been colored as old red sandstone; as in East-Hampton and Deerfield; but being so small they were neglected.

16. GEEST. Jameson.

Déluvian Detritus. Buckland.

“By geest,” says Jameson, “is understood the alluvial matter which is spread over the surface both of the hilly and low country and appears to have been formed the last time the waters of the ocean stood over the surface of the earth. And it is probable that Professor Buckland refers to the same deposition by the above synonym. By deluvian detritus, he means “fragments of neighboring and distant rocks, and with bones not mineralized—generally in valleys.” Whatever objections may lie against these definitions, every geologist knows that much deposition exists on the globe which no one refers to what is commonly understood by alluvion, and which could result from no processes nature is now carrying on. This is scattered over the most mountainous tracts, and in all cases of considerable extent, occupies at least three quarters of the surface. It is usually denominated soil, comprehending, however, the boulder stones and organic remains that soil contains. As a general fact, this geest, in primitive regions, consists of comminuted particles and rolled stones of primitive rocks. In secondary tracts it consists of secondary detritus, though more frequently mixed with portions of rocks of a primitive character.

Along the Connecticut in the primitive region, large bowlders in great numbers are not commonly found removed many miles from the spot where they originated. Stragglers of this description may indeed be found almost every where; and among all the rocks none seems to be more scattered than granite: though perhaps the numerous beds and veins of this rock found almost every where may ac-

count for this. But in general along this river, the character of the rolled masses corresponds to the rock in place underneath them ;—that is the greatest number of the loose stones are of the same description as the rock that underlies them. But to this there are many exceptions—a most remarkable one occurs a few miles west of New-Haven in Woodbridge and Milford. The surface is covered with rolled masses, sometimes quite large, of primitive and secondary greenstone, mica slate, gneiss, granite, and almost every other rock, except that which is in place viz. chlorite slate, or argillite. In many places on the map which are highly mountainous, the geest is so abundant as to occupy most of the surface ;—the subjacent rock rarely appearing ;—as in the east part of Plainfield and in Shutesbury. The diameter of the loose fragments varies from an inch to twenty, or even thirty feet, and they are usually rounded, indicating attrition. Some of the highest of these bowlders are found insulated on the pinnacles of our mountains.

There is a particular kind of geest, which I have already mentioned, occurring along the Connecticut, that does not seem to be comprehended in Professor Jameson's definitions. It is that kind of soil that results from the slow disintegration and decomposition of certain rocks, with a mixture of decaying vegetables. This, as already observed, is not uncommon above the old red sandstone and the red siliceous sandstone slate of the coal formation. And the epithet *deluvian* seems to exclude this kind of soil from Prof. Buckland's *deluvian detritus* ; and so the epithet *fluvatile* excludes it from the *fluvatile detritus* of the same author. (Rees' Cyc. Art. Geology, Addenda.)

Hayden's Hypothesis of a primeval northeasterly current of water.

I allude to Hayden's Geological Essays, in which he expresses the opinion that the alluvion of our middle and southern states was formed by a current or currents that formerly flowed across this continent from the northeast to the southwest ; and I am inclined to believe, (without intending, however, to adopt altogether his theory on the

subject,) that a careful examination of the boulder stones along the Connecticut would favor the supposition. Masses of greenstone are found at a greater distance, and in much greater quantities on the western side of the ridges than on the eastern. As we ascend the primitive region on the west side of the river, secondary rolled stones are seen for one or two miles; but on the eastern side, if I mistake not, nothing of this kind appears; and I should suppose the boulders of Woodbridge and Milford, being evidently brought from the country to the north, would testify in favor of such an hypothesis.

Suggestion concerning rolled Stones.

Is it not a fact that rolled masses are more abundant and more perfectly rounded along the limits between the primitive, and transition, or secondary? This question has often occurred to me when travelling in the south eastern part of Massachusetts, when going over the country along the Connecticut in Bernardston and its vicinity, when descending the Hoosack and Green Mountains on the west, and when passing over the country west of New-Haven. If such be the fact it may, when it occurs in the geologist's tours, be a warning to him to expect a change in the rocks in place.

Fact relating to the detachment of large boulder stones from their bed.

Deerfield river in the greater part of its course is a mountain torrent, very rapid and powerful. It has worn a passage often four hundred feet deep, the banks being almost perpendicular. Its winter floods are most powerful in effecting this work. The ice freezes three or four feet thick, and when a sudden rain melts the snows on its banks, it rises rapidly and lifts up and urges forward with tumultuous fury, this immense body of ice. As the banks among the mountains are steep and rocky, they prevent the accumulation of water and ice from spreading to the right or left, and it is raised proportionally higher; and thus an immense force is exerted upon obstacles in the bottom of the

stream, which, in winter floods, is filled with huge masses of ice to the very bottom.

In the west part of Shelburne this river descends a cataract thirty or forty feet high. The rock in the bottom of the river is an aggregate of quartz and mica with hornblende intermixed, and below the falls it is unstratified, almost without seams and very hard. Yet here we might expect the force of the torrent would be most powerful; and accordingly we find masses of this rock from one to ten feet in diameter, raised from their bed, and some of them removed down the stream one or two miles, some only a few rods, and I saw one or two of the largest but just beginning to be raised from their bed. Previous to viewing this spot, I had no just ideas of the enormous force exerted by a mountain torrent.

[Part II. in the next Number.]

ART. II.*—*A Memoir on the Catskill Mountains with notices of their Topography, Scenery, Mineralogy, Zoology, economical resources, &c.* By JAMES PIERCE, Esq.

THE Catskill Mountains or ranges connected with them, extend from the vicinity of the St. Lawrence to the Alleghany ridge. In the neighborhood of the Hudson they sweep in a semicircular form, presenting wild and irregular eminences which rise to a greater altitude than any mountains in the United States, some in New-England excepted.

The eastern face of the ridge is steep or precipitous, displaying numerous mural precipices of great extent, and often of sufficient width to be distinguished at the distance of twenty miles. They appear encircling the mountain like enormous bands.

From the summit ledges, superb views are presented of the great valley of the Hudson, and distant mountains of New-York and New-England; for extent, interest and diversity, they are unequalled in this country.

In the waving profile of the Catskill mountains many sugar loaf eminences tower above the general range. Among

*Originally read before the Catskill Lyceum, but forwarded with additions and corrections, for insertion in this Journal.

these the height near Cairo and the Round Top of about equal elevation, are the most conspicuous.

Several prominent spurs run from the eastern chain of the Catskill mountains, in a north-western direction, for several miles. The intermediate mountain vallies are mostly of a good deep medium soil, and afford, when cleared, fine grazing ground.

In a state of nature these intervals present towering forests of hard maple, beech, hemlock, birch, cherry, spruce, and balsam fir. The surface in general is not too strong for the purposes of agriculture.

The most considerable of the ranges which take a western direction, border the elevated vallies and ravines through which the rivers Kauterskill, Schoharie and Platterkill, take their course.

The clove passages formed by the Kauterskill and Platterkill in their eastern descent, present as sublime and picturesque scenery as this or almost any country exhibits.

Though there is considerable similarity in the appearance of these cloves, yet some peculiar features make an interesting diversity.

The road through the Kauterskill clove ascends gradually near the river, where there appears scarcely space for the road and stream.

In many places the traveller looks down from a perpendicular and dizzy height upon foaming waters that pursue a raging course among the rocks falling with a deafening noise from precipice to precipice.

On the northern side of the river the mountain is lofty and precipitous, exhibiting near its base stupendous perpendicular walls of argillaceous red sandstone and grey wacke slate—the strata in nearly a horizontal position. Frequently but a small section of the horizon can be seen. Mural precipices rise in succession and tower above the forest. The mountain's top, which seems almost to overhang the spectator, is crowned by enormous ledges resembling castles or fortifications in ruins, on which a few scattered pines preserve their bleak station in defiance of tempests, and wave their dark verdure over the cliffs like nodding plumes.

About two miles from the entrance of the clove the Kauterskill is passed by a bridge thrown from crag to crag over

the brawling stream, which here presents considerable cascades—The mountain seems torn asunder to give passage to the river leaving lofty perpendicular walls of rock on its borders—A short distance above, the stream falls in a circular column near one hundred feet. South of the clove the mountain rises to a great height—its steep northern side is thickly clothed with trees of varied verdure—Rivulets are seen winding rapidly down the glens or sporting in cascades.

The most considerable branch of the Kauterskill has its origin in two mountain lakes situated near the Delaware turn-pike, between two and three thousand feet above the Hudson. They cover about two hundred acres of ground, and are very shallow—no where of greater depth than ten feet. They contain cat-fish, and great numbers of the brown variety of leeches, some of them six inches in length.

The river from its outlet at the lake descends by rapids and falls, through a romantic ravine to the great clove. In one place it is precipitated perpendicularly about two hundred feet. This fall is often visited by the curious, A road has been recently worked from its vicinity down a wild glen parallel with the Kauterskill, to the clove, to facilitate access to a mountain mass of very friable, fine grained argillaceous red sandstone, supposed by the proprietors of the ground, to be valuable as a paint, although softer, and of a deeper color than the red sandstone observed in almost every ravine of the mountain, yet it does not appear to have sufficient oxide of iron to give it such a body as to form a useful pigment.

At the head of the great clove the western branch of the Kauterskill falls perpendicularly one hundred and twenty feet from projecting cliffs, and descends in rapids and cascades four hundred feet in about one hundred rods.

The Platterkill clove, situated about five miles south of the Kauterskill, is little known, except to the inhabitants of its vicinity. I recently passed up this glen by a narrow dug way which rose to a midway region of the mountain, north of the river Platterkill.

For two miles you look down the precipitous side into a deep ravine near one thousand feet, where the Platterkill pursues a raging course among the rocks, presenting numerous rapids and falls. Lesser streams are seen descending the precipitous south mountain from an altitude of two thou-

sand feet in cascades,—sometimes concealed by the forest, and then flashing to light through the evergreen foliage, leaping from ledge to ledge, until they mingle their waters with the Platterkill.

Few evergreens were observed on the north mountain, but the elevated ridge south of the clove presented an entangled forest of hemlock, balsam fir and spruce, with plats of hard maple, beech and birch. The glen of the Platterkill was filled with sugar-maple, beech, oak, chesnut, ash, birch, cherry, hemlock and spruce. Near the head of the clove the ravine suddenly rises, and the Platterkill, which on the mountain affords water sufficient for mill-seats, descends from the valley of the summit one thousand feet in a few hundred yards of its progressive course, by a succession of falls over ledges. One of these falls, which is in view from the road, is said to be one hundred and fifty feet in height. From a lofty mural precipice situated at the head of the clove, a striking view is presented of this fall and of the deep gulf below.

A saw-mill has been recently erected near the road of the summit, on the brow of a precipice overlooking water-falls and wild scenery.

The mountain valley, at the head of the clove, is tolerably fertile, but not extensively cultivated. Large tracts of pretty level ground are situated to the north and west, thickly clothed with hard maple and beech, which, if cleared, would afford a fine grazing region for sheep and cattle. Unfortunately, most of the residents on this part of the mountain are not proprietors of the soil. They prefer stripping the land of its best timber rather than resort to the regular toils of agriculture. A considerable proportion live in log huts without floor or furniture. Bread is rarely seen among them; and but few have gardens. Their principal food, in addition to wild meats and fish occasionally obtained, consists of potatoes and pumpkins. They have as few comforts as Rob Roy's band, or the Children of the Mist. Adjacent to the Platterkill road on the mountain table land, there are a few small farms under tolerable cultivation.

The ascent from the Platterkill to the base of the mountain summits, called Round Top and High peak, is gradual through thick groves of maple, birch, beech, cherry and hemlock.

The elevated valleys and regions adjacent to those peaks are peculiarly interesting. Groves of lofty spruce and balsam fir, straight as the white pine, and presenting a beautiful never fading verdure, occupy, almost exclusively, extensive tracts. Little under-brush obstructs the passage and view, but the earth and flat rocks are covered by a handsome carpet of diversified colors composed of a thick and soft velvet moss of a delicate light green, ornamented by gay flowers and tufts of white coral like silvery moss, with other species, —mountain sorrel varying the verdure.

The region north of the Platterkill mountain valley, is accessible for waggons to the base of the Round Top and from thence the ascent is easy.

I passed a night on this peak at an elevation of near 4000 feet above the level of the sea. Its circular summit is nearly flat, but slightly descending on every side, and presents about an acre mostly wood-clad.

Although the heat of the river valley was oppressive, yet the mountain temperature rendered a large fire comfortable.

Invigorated by cold and by breathing freely the pure mountain air, a traveller ranges with less fatigue than in the valley of the Hudson, and seldom fails of possessing a good appetite.

Having enjoyed a refreshing repast, and amused ourselves sometime in conversation, we increased our fire as a protection from beasts of prey, and retired to rest on beds of moss upon which small branches of spruce were spread, forming a soft and dry couch. We viewed through the thinly scattered branches of the balsam fir, the blue arch of heaven spangled with stars. The azure of the sky appeared darker from our elevation than from below, and the heavenly bodies to move more brilliantly in their course.

The atmosphere which gives a light blue coloring to distant objects, becomes more rare and pure in proportion to its elevation.

Placed far above the haunts of men, no sound was heard save that of a light air, gently breathing through the fine leaved tops of the evergreens.

We were, at times, during the night enveloped by passing clouds, but the breeze would soon free us from our dewy mantle. The starry lamps, as if newly trimmed, seemed then to shine with additional lustre. The moon partly shorn of her beams, calmly glided through the sky, motting

the woodland steeps and dispensing her influence over hills and plains.

We rose at dawn from a refreshing slumber, to view the beauties of rising day. The eastern sky and clouds glowed in the morning light. The sun soon rose with a dazzling splendor over the distant Taconnock mountains, but the immense valley of the Hudson was still clad in gloom.

Twilight is of shorter duration on elevated tracts than in valleys. This probably arises from the rare air of the mountains having less refractive power. Objects in the valley were gradually disclosed. Here and there white fogs appeared, resting on the waters. But they were soon raised in clouds by the expansive power of the sun, and, tinged with gold and purple, sailed far below us, brushing the mountains with their dewy wings, and dispensing refreshing moisture to the vegetable world.

Our prospect, from an eastern ledge of the Round Top, was indescribably grand. We had beneath us, a vast expanse like a world in miniature, which we viewed as upon a map. The Hudson, fourteen miles distant, appeared to us near the base of the mountain, diminished to the size of a rivulet or canal. It was in view from the Highlands to Albany, together with every city and village on its banks. Sloops, with all their canvass spread, appeared no larger than small sail-boats. The rising sun, gleaming on the waters of the Hudson and its auxiliary streams, and on the lakes of mountain and valley, rendered them very conspicuous. They appeared like crimson floods or lakes of fire.

The mountains adjacent to Lake George, the Green Mountains of Vermont, the elevated ranges of Massachusetts and Connecticut, were in view, and their blue cloud like summits seemed mingled with the distant sky.

The Fishkill mountain, a continuation of the primitive ranges of the Connecticut;—the Highlands of New-York and New-Jersey, and the Shawangunk ridge were distinctly traced. The intervening space or valley of the Hudson, exhibited the appearance of an immense plain, an alternation of groves and cleared fields. "The hills were laid low and the valleys exalted."

Northward, looking down on the Pine orchard and other prospect elevations, which from their base appeared of gigantic size, they now seemed depressed almost to a level with the plain. We viewed the summits, ravines, lakes

and streams, upon the broad back of the chain, to great advantage. To the west, wild wood-clad ranges and mountains piled on mountains met the eye.

A considerable diversity is presented in the views from the Catskill heights, sometimes the valley is filled with clouds resembling a boundless ocean, while the insulated summits are in the enjoyment of sunshine and a clear sky—put in motion by the wind, the clouds of the valley roll like the waves of a tempestuous sea, and storms are often seen sweeping far below, shrouding a part of the landscape in midnight darkness. You may hear the thunder roll, and see the lightning play beneath your feet, while the mountain heights and parts of the valley are cheered by the sun's rays. The mountain woodland scenery, is particularly interesting—dressed in the gay diversified colors of autumn, when the foliage of the Maple, Beech, Oak, Birch, &c. is dyed with scarlet, purple and orange, intermingled with the dark verdure of evergreens.

From the Platterkill table land, some of the peaks to the south west appear almost as high as the Round top. The prospects from their summits to the south and southwest is represented as being very striking. The quantity of hemlock in the southern section of the mountains seems inexhaustible. A tannery on an extensive scale might be advantageously established at the base of the Platterkill cove—several fine mill seats are there unoccupied; the distance from that place to the nearest landing on the Hudson, is about eight miles, and there are no heavy intervening hills. Trout are abundant in many parts of the Platterkill, Kauterskill, Schoharie and most of the mountain streams.

About three miles south of the Platterkill and at a great elevation above the Hudson, a deep body of water one mile in circumference, called Shues lake is situated, and is environed by an amphitheatre of wild, rocky, and steep mountains. It contains trout of large size.

A mineral spring of a chalybeate character, is said to occur in its vicinity. A mill stream called Saw-mill Creek has its origin in this lake and winds rapidly for five miles down the mountain glens without presenting any considerable falls. Passing through the valley of Woodstock, it becomes auxiliary to Saugerties creek. A beautiful circular basin of water four miles in circumference, called Shandago lake is situated in the southern section of the moun-

ains adjacent to the Bristol turnpike and glass manufactory. It is deep, containing Pickerel, Trout, Perch, and other fish.

Several streams which have their source in the mountains to the westward of this lake, and pass through romantic ravines, are uncommonly well stored with trout. Five hundred of these fish have been caught by an angler in a day.

Residents of the mountains informed me they had observed a large cave in the region south of the Platterkill into which a boy had been introduced twenty feet perpendicularly by a rope before he reached the bottom. He explored a considerable distance without finding a termination. The fact is interesting from its indicating either a limestone region, or a rock decomposing readily from its containing much sulphuret of iron, alum or coal. Caves of considerable extent are rarely found except in secondary or transition limestone, the excavations being made in the soft calcareous rock, by the friction of water.

Panthers, wolves, bears, wild cats, and deer are occasionally seen in the southern section of the Catskill mountains, but are not so numerous as in the middle region. A Panther measuring in length about nine feet, was recently killed in the southern range; this animal is rarely seen; but from its strength size and ferocity, it is regarded with terror and considered the most formidable beast of the forest; their color is grey, the head small in proportion, the general form indicating agility; they have been known in ascending a ledge or tree, to rise at a leap twenty feet from the ground.

Of wolves, two varieties inhabit the Catskill mountains; one called by hunters the deer wolf, from his habit of pursuing deer, for which his light greyhound form adapts him. The other of a more clumsy figure with, short legs and large body, more frequently depredates upon flocks under the protection of man. Foxes and rabbits are numerous, and white hares, martins and hedgehogs sometimes seen, squirrels seldom.

Rattlesnakes frequent the warm sides of the Catskill mountains, but are rarely observed on the summits or northern declivities and ten miles in the interior of the range are never seen. They are in general about 4 feet in length—the skin of one recently killed near Shues lake was exhibited to me; it measured between five and six feet. The color of the male is darker than that of the female, they live to the age of twelve and fifteen years.

Copperhead serpents inhabit the lower parts of ravines and eastern face of the mountain, but are not found on the summit.

The black, water, striped, and milk snakes are among the harmless reptiles.

The Catskill mountains, in wild grandeur and romantic beauty, can compare with the highlands of Scotland, without presenting their barren heath-covered aspect, being from the base to the summit thickly covered by forests.

The eastern face of the mountain, though steep and precipitous, supports an almost impenetrable forest. The ledges form natural terraces that arrest the vegetable mould.

In the valleys and gradually declining mountain surface of the interior, trees of great size appear, indicating a considerable depth of good soil.

Gradations of elevation on the mountain are in some degree marked by a change of vegetation both as it respects the species and periods of blossoming, and the maturity of fruit. The lower districts and the warm southern exposure of ravines, exhibit trees and plants common in the river valley—oak, chesnut, soft and hard maple, ash, and cherry, mingled with a few evergreens. On the peaks, on the cold northern sides of ranges, in moist shaded ravines and elevated valleys, the trees and plants of the green mountains and northern parts of New-England occur. You there see thick groves of hemlock; spruce, balsam fir and pitch pine, mingled with hard maple, beach, white and black birch, and cherry. The white pine is not observed on the eastern range of the Catskill mountains but is found in the valley of the Schoharie and adjacent hills of moderate elevation.

Among the mountain shrubs, the blackberry, thimbleberry, gooseberry, and moose-bush, are noticed; the whortleberry is very abundant on the rocky summits, and is the favorite food of bears. The plants of the mountain blossom much later than those of the valley, and a botanist can collect plants of different latitudes, or which blossom at different periods in one day's research.

There are three descriptions of rocks on the Catskill mountains common to the whole chain, and which alternate with each other, viz. red sandstone, gray wacke, slate and puddingstone. The sandstone is of a fine texture, highly colored by oxide of iron and contains much alumine. It is

found at various elevations, but most frequently as a lower stratum, and is observed in deep ravines. It is least abundant in the section south of the Platterkill. This argillaceous sandstone, exposed to air and moisture, decomposes easily and forms a good soil.

A second and most common variety is a coarse gray wacke slate, which lies in regular strata, the position in some places horizontal, but in general with a small inclination to the west. It is composed of silicious grains with an argillaceous cement. The third description of rock is a pudding-stone containing smooth, and apparently water worn pebbles of different sizes of white, red, and gray quartz, combined by argillaceous, and fine silicious materials. The ledges of pudding-stone which are often of great height and extent, are most frequently remarked in the upper regions of the mountains.

Ledges of gray wacke slate and argillaceous sandstone, richly impregnated with alum and often embracing sulphuret of iron, are of frequent occurrence.

Native alum is abundant near the Schoharie in the town of Blenheim. It is found in a ledge near the foot of the Kauterskill cove, and in the rocks of the eastern side of the mountain north of the Kauterskill for several miles, sometimes pendant in stalactical form. Alum often occurs in the southern section, both on the eastern face of the range, and in gray wacke slate of the interior ravines, sometimes in incrustations, lumps and stalactites. Profitable manufactures of alum may perhaps be established in the Catskill mountains. The salt can in some places be extracted from the decomposing rock by lixiviation alone, but in general a calcination would probably be necessary.

Sulphuret of iron has been frequently noticed in the southern part of the mountains, and plumbago in a few places. There are indications of copper. Several tons of iron said to resemble that of the highlands were procured from the Catskill range, in the vicinity of the Bristol glass manufactory, but diminishing in quantity, the mine was abandoned.

I have observed narrow strata or seams of coal at several places in the southern part of the Catskill ridge. The widest is situated in a perpendicular ledge of gray wacke slate on the eastern face of the mountain, in the town of Woodstock, Ulster County, at an elevation of about 1000 feet above the

Hudson. This seam which has been recently explored, is eight inches wide on the surface, and is observed for some distance on the face of the ledge. The coal is stratified, and inclines with the rock at an angle of near fifteen degrees. Narrow strata of argillaceous slate, imbedded in the gray wack ledges, form the roof and floor of the coal bed. This slate contains alum, and cubic crystals of sulphuret of iron, and sometimes presents a dark surface glistening with carburet of iron.

The coal bed, in exploring, widened to twenty-two inches; but diminishing in the interior to a narrow seam and the adjacent rock being of difficult fracture, the pursuit has been abandoned for the present. Another vein of coal is located in a higher ledge of the same mountain, and coal has been noticed to the south west in this range for three miles. The coal of the Catskill mountain appears of a good quality for upper strata. It is light, shining, and burns with a moderate flame proceeding from bitumen or sulphur.

If beds of coal of this description could be found five feet in thickness they might be penetrated without breaking the rock, and would be valuable. Vegetable impressions and narrow seams of coal have been found in gray wacke slate, in the Catskill range bordering the river Schoharie.

Flames, from spontaneous combustions, generated in beds of coal or sulphuret of iron have been seen issuing from the ledges of the Catskill mountains by the neighbouring inhabitants. Combustions of this character often occur in the coal districts of Europe and America.

Adjacent to, and forming a threatening canopy over the entrance of the coal excavation in the mountain near Woodstock, is a rock of several hundred tons weight. It is separated from the ledge and balanced on a narrow base of decaying alum slate by an opposite projection of equal weight. From progressive decay this base is lessening, and the rock will before long be precipitated down the steep side of the mountain. The ledges in this neighbourhood are fast decomposing in many places, from the quantity of alum and sulphuret of iron they contain.

The eastern side of the Catskill mountains south of the Kauterskill cove is steep, but thickly clothed with wood; near this cove at a considerable elevation is noticed an immense circular basin resembling a volcanic crater. A basin

of similar appearance is situated near the Platterkill ravine. Numerous small precipices are presented on the mountain's eastern face, some of them of great altitude; those of a southern promontory bordering on the town of Woodstock, are particularly striking; they rise tier above tier in amphitheatric order from the base to the summit of the mountain, in quick succession and great regularity. Upon the summit of each natural terrace is a narrow plain on which the soil accumulates. Many of the ledges of this promontory are in a crumbling state from embracing saline minerals. In some of the higher rocks, wide strata had mouldered away, leaving tabular masses of firm gray wacke slate, projecting twelve and in some places twenty feet. It is probable that this mountain is uncommonly rich in materials for the manufacture of alum and copperas.

From the above mentioned promontory which is situated about ten miles south of the Kauterskill clove, the Catskill mountains tend to the south west and sweep with diminished height to the Delaware. About four miles to the west of the village of Woodstock, a spur of considerable elevation strikes off to the south east, leaving a rich and extensive interval of semi-circular form. At the angle of intersection of these ranges, the Bristol glass works are situated. Window glass is the principal article manufactured, and four miles north east of this establishment in an elevated and secluded mountain valley, another manufactory of glass has been erected. Sand for these manufactories is procured from Philadelphia and the sea coast, and the other materials from a distance. The advantage resulting from the cheapness of wood and soil, will not compensate for the enhanced expence incurred in transporting the ingredients of glass, and the bricks, stone lime and clay, for the furnaces and crucibles, and many of the necessities of life, sixteen or twenty miles over mountain roads.

A small hamlet of about thirty houses has been erected adjacent to the upper or mountain glass house, on ground favorable for gardens and meadows. North of this village, an elevated, wood clad and steep mountain, ranges to the westward; its wildly irregular waving summits are several miles in view.

ART. III.—*Some speculative conjectures on the probable changes that may have taken place in the Geology of the Continent of North-America east of the Stoney Mountains ; by WILLIAM MACLURE, Esq. President of Academy of Natural Sciences, at Philadelphia, and of the American Geological Society.*

MADRID, July 9, 1822.

IN the present state of our geological knowledge, there are, perhaps only a few facts from which we are permitted to draw conclusions respecting the former state of the earth; amongst which is our entire ignorance with regard to the origin or formation of the primitive class of rocks, we having as yet had no opportunity of observing nature in the act of aggregating or forming such rocks: the other four classes of Volcanic, (Volcanic?) Alluvial, Secondary, and Transition, we have either caught nature in the act of aggregating or forming such rocks, or rocks that from direct analogy are so similar in their construction, relative situation, &c. &c. as to warrant a deduction that they were most probably formed after this same manner.

Water appears to be the principal agent in changing the form of the earth's surface, and by the sea, lakes, and rivers, (the most extensive mode of operation;) when we see a river running between two precipices of rocks in a deep channel, whose stratification and arrangement are the same on both sides of the river, we are naturally led to suppose that the action of the running water wore down that channel, and that at some former period, the two sides of the river, now separated, were contiguous and unbroken: when we cast our eyes over immense tracts, such as the steppes in Russia, the prairies in the United States of America, or on plains that are nearly horizontal, we are tempted to conjecture that the earth took that form from the depositions from water, &c. &c. &c.

The continent of North-America, east of the stoney mountains consists of a ridge of primitive mountains, springing out of the great northern primitive formations, covered to the east and south-east by extensive beds of alluvial, apparently the depositions of the ocean, and on the west side overlayed by Transition and Secondary, filling the immense basin through which the Mississippi now runs with all its attendant streams.

The utmost stretch of imagination or conjecture can form no idea of any period of time, when that primitive chain of mountains called the Alleghany, did not exist; but direct analogy, and perhaps logical reasoning, authorises us to conjecture that there must have been a period, though beyond the date of our records, when neither the alluvial of the ocean, nor the Transition or Secondary depositions covered or overlaid either side of said range of mountains, and that the chain of mountains called the Alleghanies stood alone, and from the nature of the depositions which we now find covering each side, we may have a right to conjecture that it was surrounded by water; into which run all the rivers that drained said mountains, forming channels deep in proportion to the immense length of time they may have run, and consequently much more profound than the channels they afterwards wore in the level country at the foot of the mountains on the retreat of the waters; at this present time all the waters that fall into that immense basin west of the Alleghany mountains are drained off principally by the Mississippi and St. Lawrence, and a small part now by the Hudson, although it is probable that formerly a greater proportion used to pass by that channel; these then are the only rivers that break through the whole chain of the Alleghany mountains, and run into the ocean.

If on a review of any existing series of phenomena, it is permitted to form conjectures on the past, and to look back on the probable changes, that may have preceded the present state, we presume that the situation of this continent will warrant such conjectures, and we should be naturally led to suppose, that at some former period, the continuity of the great chain of mountains was unbroken, by any of the three rivers that now drain the great basin; and that the waters confined by the high surrounding ridge would form an immense lake, the surplus of which would naturally fall over the ridge into the ocean, and would in the course of time cut those passages, which would drain said lake, and leave the great interior basin, with all its secondary or deposition formation, as we now find it: as the waters that would fall over the ridge into the sea, must have previously left the sediments in the lake, there would be little or no matter fit for alluvial depositions; and more probably that great alluvial formation, from the bay of Mexico to Long-

Island, would not have been accumulated at this period, and the current now called the Gulf Stream, would have then most probably run along the foot of the chain of mountains.

The continent east of the Stoney Mountains, and south of the north edge of the great lake, would then consist of an immense lake, surrounded on the east and south side by a strip of high land from one hundred to two hundred miles broad; the rain falling upon which would partly fall into the lake and partly into the ocean, through small rivers, along the mouths of which navigators might have in vain searched for rivers proportionate to the apparent extent of the continent, as they now do on the coast of New South Wales, for rivers capable of draining so extensive a country.

The passage of the St. Lawrence through the high ridge between Quebec and Montreal, must either have been torn asunder by an extraordinary convulsion, been always in that state, or it must have been worn down by the gradual but continued action of running water, aided by the friction of all the substances it carries along with it; the undisturbed regularity of all the surrounding strata both on the banks of the St. Lawrence and Hudson, renders the first supposition improbable; on the second supposition that the river had always run freely through the passage in those mountains, it must follow that the river had always run in its bed from Lake Ontario to Montreal, and from the weight of water and rapidity of its current, for so long a time, must have worn down a deep channel, and buried itself between high and perpendicular banks; but this does not correspond with the actual state of the river, which from the lake to the rising ground above Montreal runs in a bed very little below the level of the surrounding country, nor does either the present situation of the river or its banks, warrant the supposition that the action of the current had continued so long: by the same supposition the level of Lake Ontario must have always remained as far below the level of Lake Erie as at present, and the waters must have constantly fallen over the ridge at Niagara; but the small progress it has made in wearing away that ridge, compared with the effects of other rivers, (for instance, the Rhine below the lake of Constance with a tenth part of the water has worn a deeper bed ten times the distance through the high lands composed of harder materials) is against the probability of such a supposition;

the small distance that the falls of Genesee river have worn its bed from the lake, with the shallow beds of the Oswego and all the other rivers that run into the lake, as well as the general nature of all the Genesee country, opposes the probability of the supposition or conjecture.

The above observations are equally applicable to the beds of the Hudson and Mohawk, before they fall over the ridge, from which it would appear that the most rational conjecture would be, to suppose the St. Lawrence wore down a passage through the high lands between Quebec and Montreal, as well as the Hudson, through the high lands above New-York, and until they had effected such a cut, the whole basin on the west side of the mountains, was the bottom of an immense lake.

A similar mode of reasoning supports the conjecture that the basin of the Mississippi made part of the said lake, for the Tennessee river, while in the mountains under the name of the French Broad, has worn down its bed one hundred to two hundred feet in solid primitive and transition rocks, but when it comes into the basin, it is obstructed in its passage, at the Muscle Shoals, by a soft secondary sandstone; the sources of the Ohio, under the name of New River, &c. &c. &c. have likewise cut deep beds in the mountains before they reach the great basin, but after their union into one great stream, the Ohio is obstructed at its falls near its mouth by a secondary limestone; from all which it would appear probable, that, had those rivers run as long through the secondary formation of the great basin, as their sources must have done to wear these beds so deep in the primitive mountains, the accumulated waters of both the Ohio and Genesee would, long ere this, have worn away all the obstructing secondary rocks, and like all other great rivers that have run long in the same beds, would have been obstructed only by alluvion of their own formation. The Rappahannock, Potomac, James River, Roanoke, &c. &c. &c. that run into the Atlantic, have cut deep beds in their course through the mountains, through the level country their channels are shallow, and they all fall from twenty to thirty feet over the granite ridge into tide water, without having removed, the fall half a mile from where they begun, which could not have been the case had they run as long in the low country, as they had in the mountains.

That the branches or sources of these rivers should have run longer in the mountains than they have in the great basin or lower country, can be satisfactorily accounted for, only by supposing that they had long been wearing down these beds in the high lands before the great basin or lower country emerged from the waters, and that it has been only since the draining of those waters that their accumulated junction in the bed of the great basin under the level country began the formation of the channels they now occupy.

This conjecture may likewise account for some of the particularities in the state of the animals, originally found on this continent, such as the small number and wild condition of the wandering herds found on this part of the continent, when compared with their neighbours inhabiting the elevated plains of Mexico; the great deficiency in Terrestrial Quadrupeds, compared with the vast abundance of Beavers, Otters, Muskrats, and other amphibious or aquatic animals; the great proportion of Gramivorous and the small number of Carnivorous; the immense flocks of aquatic birds, and the very few terrestrial; might be mentioned as some of the problems solved by the foregoing supposition.

The accounting for the existence and extinction of the mammoth would not be difficult, by supposing with Mr. Peal that it was not amphibious, and though originally inhabiting the southern parts of the great lake, might in summer occasionally emigrate to the north, and leave their bones on the borders; being deprived of its element by the evacuation of the great lake, might perhaps be considered as sufficient good reason for their extinction.

The large masses of granite, some of them weighing tons, scattered over the secondary between Lake Erie and the Ohio, while there is not an atom of granite in place nearer than the north side of the lake, would seem to point at the only mode by which they could probably be transported; by supposing the lake extended thus far, and that the large pieces of floating ice from the north side might carry those blocks attached to them, and drop them as the ice melted in going south; few or none being found south of the Ohio, shows that the southern sun melted the ice before it got so far.

BOTANY.

ART. IV.—Description of a New Species of *Botrychium*; with a drawing; by the Rev. EDWARD HITCHCOCK, A. M. of Conway, Mass.

THIS species grows, not very abundantly, in Conway, Massachusetts. It was first noticed, two years since, and with some doubt, referred to *Botrychium lunaria* of Swartz and Willdenow. But upon a suggestion of Dr. Torrey that it might be a new species, I have several times re-examined it during the two past summers, and feel so confident that it is specifically distinct from any described *Botrychium*, that I take the liberty to propose for it the name *B. simplex*.

Specific Character.

Botrychium simplex: Frond simple, 3 lobed, or 3 cleft; segments unequal; spike sub-compound, interrupted, unilateral, bearing sessile capsules, in the last part of June, of the size of a mustard seed. In dry hilly pastures.

Frond solitary, from a torn membranous sheath, erect, two to four inches high, glabrous, pale green, consisting of a small spatulate leaf, an inch long, and one third of an inch broad, usually divided into three—rarely four—unequal, somewhat rounded segments, with their margins a little notched. From the base of the leaf, about an inch from the ground, springs a stalk, twice or thrice the length of the leaf, bearing a sub-compound, unilateral, interrupted spike of capsules, sub-two rowed. Root sending forth stout simple fibres.

This species is closely allied to *B. lunaria* of Europe: but it differs in having a simple, instead of a pinnate leaf “with six or seven pairs of obliquely imbricated, fan-shaped, entire, or notched leaflets.” (Smith in Rees’ Cyc.) And this difference exists in all the specimens, (more than 100) which I have seen—not one being pinnate, or even “pseudopinnate.” (Nuttall.) Also, in having a spike hardly com-

pound; the small branches, that appear along its sides, being scarcely any thing more than an expansion of the common receptacle—whereas in *B. lunaria*, the spike is “twice or thrice compound.” Also, in the capsules being twice as large, and the plant half as large. If I am correct, therefore, this species will take its place as the first under the genus; all the other *Botrychia* having compound fronds.

ART. V.—*Description of a new species of Usnea, from New South Shetland; by JOHN TORREY, M. D. of New-York, (with a drawing.)*

TO PROFESSOR SILLIMAN.

Sir,

THE following account of a new cryptogamic plant from New South Shetland, with an explanatory letter from Dr. Mitchill, I send for insertion in your valuable Journal.

Letter from Dr. S. L. MITCHILL, to JOHN TORREY, M. D.

New-York, July 1, 1822.

My Dear Sir,

AMONG the subjects of rational attention at this time, is the land lately found, and now much frequented, beyond Cape Horn.

Having received from several of my friends, who have visited that antarctic region, articles of a zoological and mineralogical kind, which they had brought home, I was naturally induced to inquire for botanical productions. In answer, I was informed that, notwithstanding the frequency of lava and volcanic slag, and the occasional eruption of smoke from the earth in different places, the surface was generally covered with ice and snow, even during the southern summer. There is not a shrub, nor a tree to be seen; nor any appearance of verdure to cheer the prospect.

Captain Napier however improved the opportunity of examining a rock upon an island of the group called New

South Shetland, from whose top the snow had been melted; and of gathering specimens of a small vegetable which grows upon it. These he presented to me for consideration. I beg you to accept some of them for your herbarium, with a request that you would communicate to me your opinion respecting them. I show you also another sample of this vegetable, brought from a different place by another person, that you may compare them.

Captain Mackay informed me, he had seen a few tufts of dwarfish grass; but as this is rare, it may have been introduced by some visitor or from some ship.

According to this view of the matter, the Flora of this new world consists of a single species; which I hope you will be very particular in describing.

While I thus lay before you this interesting production, I congratulate you on the receipt of numberless other productions from foreign climes, which our spirited navigators are incessantly presenting to us.

The specimens presented to me by Dr. Mitchell, evidently belong to a species of Lichen. Several of them were covered with small tubercles very much resembling the fruit of *Roccella*, which, with the *habitat* of the plant, induced me to refer it to that genus. On a closer examination, however, I have no doubt of its being a species of *Usnea* without the proper fruit, merely having the *cephalodia* which are not uncommon in *U. florida*, &c. It has the central hyaline thread, so constant and important a character in this genus. According to Acharius, all the *Usneæ* are found exclusively on trees: so that this species, which grows on rocks appears to form an exception to all the rest. In the *Flore Francais*, however, the *U. florida* is said to occur sometimes on rocks and the *U. articulata* on the ground. The present species does not appear to be described in the *Synopsis Methodia Lichenum* of Acharius; I have therefore considered it as a new one, and have called *U. fasciata*.

USNEA ACHARIUS.

RECEPTACULUM *universale* subcrustaceum teretiusculum, ramosum plerumque pendulum, fasciculo ductulorum filiformi elastico centrali hyalino percussum. *Partiale* orbi-

culatum terminale peltatum totum a thallo formatum ejusque substantia corticali similari undique obductum subconcolorum, ambitu immarginato plerumque ciliato. *Ach. Syn. Meth. Lich.* p. 303. ejusd. *Lich. Universal.* p. 127. t. xiv. f. 5.

USNEA fasciata mihi.

U. thallo pendulo scabriusculo tereti glauco virescente ramosissimo, ramis rectis nigro-fasciatis quasi articulatis, ramulis ultimis capillaceo-attenuatis, fibrillis lateralibus nullis, cephalodiis sparsis hemisphericis atris.

Description.—From two to three inches long, and probably pendulous, roughened by minute papillæ. Common trunk short, about one line in diameter; branches dense tapering to a filament at the extremities and appearing beautifully articulated by transverse black bands; the joints rather longer than the diameter of the branches. Apothecia—none in the specimens I have seen. Cephalodia scattered, sometimes crowded and irregular.

Habitat.—On the perpendicular volcanic rocks of New South Shetland.

Observations.—This species is nearly allied to *Usnea articulata* of Hoffman and the *Flore Francaise*, which is considered as a variety of *U. barbata* by Acharius, but the latter is distinguished by its gray colour, dichotomous branches and ventricose joints, &c.

EXPLANATION OF THE PLATE.

- Fig. 1. The plant of its natural size.
 “ 2. A branch magnified.
 “ 3. A cephalodium magnified.
 “ 4. A transverse section of the same highly magnified.

CONCHOLOGY.

ART. VI.—On the Genera *Unio* and *Alasmodonta*; with Introductory Remarks: by D. W. BARNES, M. A. Member of the New-York Lyceum of Natural History.

[Read before the Lyceum.]

INTRODUCTORY REMARKS.

THE family of the *Naiades*, according to *M. Lamarck*, contains four genera of fresh water Bivales, viz. *Unio*, *Hyria*, *Anodonta* and *Iridina*. To this family belong the *Dipsas* of *Dr. Leach*, and the *Alasmodonta* of *Mr. Say*. Several undescribed species of the Genera *Unio* and *Alasmodonta*, were brought to our knowledge by the expedition sent by our government in the summer of 1820, under *Gov. Cass*, to explore the North Western Territory; and others have since been obtained from various sources.

Little has hitherto been done by our countrymen in describing these interesting productions of our lakes and rivers. The only American work, of the kind, at present known, is that of *Mr. Thomas Say*, who published at Philadelphia in the year 1819, "A description of the land and fresh-water shells of the United States." This treatise had been previously published in *Nicholson's Encyclopedia*. It deserves the thanks, and ought to be in the possession of every American lover of Natural Science. It has been quoted by *M. Lamarck*, and adopted by *M. de Ferrusac*, and has thus taken its place in the scientific world.

But *Mr. Say's* tract, though a very commendable performance, was necessarily imperfect. The author himself has described *thirty new species* of univalves since the publication of his book, and a great part of the splendid collection, brought from the N. W. Territory, was unknown to him. For our first view of them we were indebted to the zeal and

liberality of *Mr. H. R. Schoolcraft*, Mineralogist to the expedition, who collected them at the expense of much voluntary fatigue, transported them a thousand miles, and generously distributed them among the lovers of Natural Science, in New-York and Philadelphia.

A second parcel was soon after received from *Capt. D. B. Douglass*, Professor in the Military Academy at West-Point, and topographical engineer to the expedition, whose avowed object, in sending his collection, was that it might be arranged and described for the American Journal of Science and Arts. To this gentleman we feel ourselves much indebted, for his valuable and detailed account of the localities of his specimens. What adds to the value of these collections, is, that independent of the numerous species and varieties before unknown, the specimens of the previously ascertained species are in many instances, remarkably large and beautiful.

M. Lamarck, in the sixth Volume of his "*Animaux sans Vertebres*," has described twenty-six* species of North American Uniones. He was moreover in doubt of the localities of several others, which will probably be found to be American. Whether he has, as we strongly suspect, described some of our species under four or five different names, cannot be certainly determined, as his book contains no figures, and the descriptions are short and equivocal. *The Unio purpureus* of *Mr. Say*, *purpurascens* of *M. Lamarck*, is common in all our eastern waters, and has a different appearance from every locality. In the Hudson it is small and short; in the Housatonic, long and slender; in the Saratoga Lake, of middling size; in the Kayaderosseras, thick and heavy; in the Lakes of New-Jersey, large and ponderous. If these are to be made different species, we may as well make four or five different species of the common clam, *Venus mercenaria*, Linn. from as many different localities around New-York. They are really unlike. Not only is the appearance of the shells different to the eye of the naturalist, but also the taste of the included animals, to the palate of the epicure. Who does not know that the Indian corn *Zea Mays*, assumes a different appearance in every latitude from Quebec to Florida? Yet whoever thought of

* For eight of these, he quotes *Mr. Say's* book, which contains nine.

making these varieties, different species? We have examined shells from the localities mentioned by *M. Lamarck*, and compared them with his descriptions, and, if we do not mistake, he has fallen into the error of making distinctions without a specific difference. But, even if this is admitted, we shall not be disposed very severely to censure, so long as anatomical dissections have not been, and in many cases cannot be called in to decide the question; for it is, after all, upon the *knife* that we must depend for perfect accuracy in this and similar cases. In the mean time, it has been agreed upon by naturalists, to arrange these animals by their shells; presuming always that a different form and figure of covering belonged to an animal of a different organization. It is impossible to decide whether they are "the common children of common parents," or otherwise. This is a case precisely similar to that which occurred between *Linnaeus* and *Lamarck* concerning the Olives. "The former expressed a doubt whether there is more than *one* species of the Olive, and the latter has described *fifty-nine*."*

In most cases wherever *M. Lamarck* can find a difference, though by his own account, "*nothing remarkable*,"† he makes a different species. Too many as well as too few distinctions undoubtedly defeat the object of the Naturalist, which is to make his readers acquainted with the productions he describes. In the present state of our knowledge we cannot perhaps do better than to take a mean course, and where the discriminations are sufficiently obvious, in *important parts and essential particulars*, to apply a different specific designation. This course has been attempted in the following notice of undescribed species. We have had the opportunity of examining and comparing a great number of specimens, and very rarely have we given a new specific name to a solitary individual. In cases where the contrary has, from necessity, been done, the specimens were by no means of a dubious character; but healthy, well-grown and perfect individuals, so strongly marked and distinctly characterized, as to leave no doubt.

* Dillwyn, page 514.

† See *U. Georgina* and *Glabrata* of *Lamarck*.

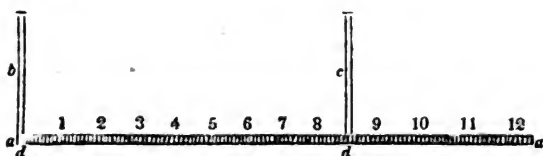
M. Lamarck has confessed the great difficulty of determining the species of the genus *Unio* on account of their "shading and melting into each other in the course of their variations." This difficulty is surely not obviated by short and equivocal descriptions. Short definitions may have an appearance of scientific neatness, but their brevity is an insuperable obstacle to a learner, especially when, as it commonly happens, the same terms are applied to different species. *M. Lamarck* applies the term *ovate*, either by itself or compounded with another word, to the description of *thirty-two*, out of his *forty-eight* species. Now it will be apparent to every one that, as this is made a leading feature in his descriptions, it must be the cause of endless perplexity to the unlearned, and of constant uncertainty even to the experienced. For the purpose of *discrimination* it is useless, and might almost as well have been omitted, unless it had been placed at the head of a section.

M. Lamarck dwells most on the external form, and with a great latitude of compound epithets, he has not succeeded in making his descriptions intelligible, without danger of mistake to those who have not seen his specimens. Ten or twelve latin words cannot so describe a *Unio* as to identify it, and distinguish it from all others. We have therefore adopted full descriptions, the obvious utility of which needs no comment. If short definitions are insufficient, full descriptions become absolutely necessary. *M. Lamarck*, generally mentions the breadth of shells in Millimetres, which we have reduced to inches and lines, or what is the same thing, to inches and decimals. The multiplier $\cdot 039371$, which multiplied by any number of Millimetres gives the corresponding English expression, as, *Unio Crassidens* 105 Millim. $105 \times \cdot 039371 = 4\cdot 133955$ or four inches and 1 line. Dividing the English inches by the multiplier, will reduce *Mr. Say's* measures to *M. Lamarck's* by which means they may be more readily compared. For ordinary purposes $12\frac{1}{2}$ Millim. to half an inch, and 4 inches to 100 Millimetres, will be sufficiently exact.

But the breadth, or as *Lamarck* often says the "*apparent length*" of the shell is nearly useless without the length; for two shells may be of the same breadth, and yet differ totally in their other dimensions. For instance, the *U. Crassus* and *U. Nasutus* may each be 26 lines broad; but the *Cras-*

sus may be as long as it is broad, while the *Nasutus* is only 1 inch, or 10 lines long. The former may weigh more than half a pound, the latter less than half an ounce. The former may be half an inch thick, the latter, as thin as paper. And to say that one is broad and the other narrow, does not obviate the difficulty; for these terms are altogether comparative, and, without something for a standard, convey no definite ideas.

We have therefore adopted an improvement which we hope to see become general in the description of Bivalves, that is, to give the length from the summit to the opposite margin; the breadth between the lateral extremities, and the diameter through the disks, at right angles to both the length and the breadth; that is, the thickness through the most prominent part of the body of the animal. We prefer the term *diameter* to *thickness*, because the latter is often applied to the substance of the shell; the former never. In determining these dimensions with ease and accuracy, we have constructed a convenient instrument of the following description;



a, a, is a box-wood ruler, one foot long, graduated on its upper side, in inches and lines. *b, c*, cross bars, made to stand at right angles, and drop down by hinge joints, *d, d*, upon the ruler, for the convenience of packing. The bar, *c, d*, slides upon the ruler by means of a clasp. The shells, to be measured, are placed between the bars, and the length is read off from below. The instrument measures any irregular body or figure, from one line to one foot in diameter. When used for measuring shells, it may be called a *Conchometer*.

One advantage of thus measuring shells, is, that those of the same species, or the same variety, will be found to have very nearly the same proportions which will hold good as it regards all the varieties of age. These proportions may be

called the *law of the species*, and every *Unio* which has the *same proportions*, may be presumed to belong to the *same species*.

Another obvious advantage of this method will appear in the following remark. The *Unio* which we have designated *praelongus*, is perhaps the *Unio purpurata* of *M. Lamarck*, all the terms of his description may be applied, and probably with truth, to our shell. But then, he "believes that his shell came from the great Rivers of Africa." This caused a doubt. Had he stated the very remarkable proportions of our shell, the identity would have been instantly determined. Had he stated the proportions at all, there could have been no doubt. We have put it into *his* power to settle the question with certainty.

Writers on *Conchology* differ very much concerning the *right* and *left*, and the *base* of Bivalves. *M. Lamarck* and the authors of the *New Edinburgh Encyclopedia* consider the *beaks* as the *base*, and the opposite parts, the upper margin: and they give the following direction for *right* and *left*. If the shell is placed upon its base or hinge, with the ligament *behind*, then the *right* and *left* sides of the shell will correspond with those of the observer. Burrow on the contrary considers the opposite part to be the *base*, and the *beaks*, the *summit*, and says, "If the shell be placed on its base, with the area *in front*, and the valves be then divided, the *right* valve will be opposite the *left* hand of the examiner, and the *left* valve opposite the *right*." By placing a Bivalve in the manner directed, it will be perceived that the two are directly opposite, the *right* of one is the *left* of the other. The view which we have hitherto had of these parts, and with which *Mr. Say* agrees, is expressed in the following directions: Place the shell upon its base with the beaks upward, and the ligament *before*, (that is *from the observer*,) the *right* and *left* valves of the shell will correspond with the hands of the observer. With due deference to the high authority of *M. Lamarck*, there seems to be a propriety in calling the *base* of a Bivalve, that part which is *downward*, and from which the *foot* projects when the animal is in motion. But when the *Unio* does not, as some authors seem to suppose, move on its beaks. The beaks are upwards, and should therefore be called the *back* rather than the *base*. This makes a simplicity, in the language of Con-

chology, which is very desirable in every science, that *the same terms should have a uniform meaning*. Having learned in univalves what is the mouth and what is the base of a shell, we apply the same terms to bivalves; but to call the thin, sharp, unconnected edges of a shell, the *dorsum* or *back* would sound very strangely. *M. Lamarck* has not ventured on so strange an expression; but says commonly the *upper margin*, the same that *Mr. Say* calls the "*basal edge*." According to *this* view of the subject we should agree with *M. Lamarck* and the *Encyclopedia* as to *right* and *left*, but not as to *base*; and with *Barrow* as to *base*, but not as to *right* and *left*. *We call the connected part of a bivalve the back and the opposite the base*.

If this is determined, there will remain another point to be settled. Authors have very generally agreed in calling that side of the beaks in which the ligament is situated, the *anterior*, and the opposite, the *posterior*. "But rigidly speaking," says *Mr. Say*, "we seem to be all wrong in our adaptation of these relative terms, because the latter is used to indicate that part of the shell which covers the mouth of the included animal, and which is foremost in its progressive movements. In order to be correct in descriptions where the animal is referred to, these terms must be reversed, and if in descriptions which have reference to the animal, certainly the principle applies to all other bivalves, in which the mouth is similarly situated. The mouth ought *always* to be considered as in the *anterior*. For this reason, *Cuvier* reverses the terms *right* and *left*, applying the former to that valve of the *Uniones* which has but a single lamelliform tooth, and which is our *left* valve.* He of course, reverses the *anterior* and *posterior* as now applied."† It would surely be deemed safe to follow an author so pre-eminent as *M. Cuvier*, and this mode of viewing the shell is doubtless most conformable to nature; but as all other authors have a different view, we have resolved, *for the present*, to adopt the established usage of the term *anterior* and *posterior*, and to follow *M. Lamarck* as to *right* and *left*.

If we rightly understand the celebrated French Naturalist, he is under a mistake in saying that the *Uniones* "keep

* This agrees with *Barrow*.

† *Mr. Say's MSS.*

themselves buried in the mud, having their beaks turned downward."* If he means by this that they are *usually concealed*, or that they lie *on their beaks*; we remark that, as it regards those of *our country*, such is not the fact. In winter they may bury themselves, but in summer we have found them, generally, when at rest, standing with the posterior side inserted obliquely, and the hinge margin the anterior slope, and a small portion of the basal edge exerted. Even when they sink below the surface the place of their retreat is conspicuous. In streams which have a rough bottom, and rapid current, they choose the narrow crevices between the stones or under the edges of rocks, and thus defend themselves from injury. We have never found a live *Unio* on its *back*, or on what *M. Lamarck* and his followers would call the *base*.

While standing in the position above described, they have the anterior side slightly gaping, but on being touched they instantly close. They are usually found in company, rarely solitary; and the sand of the bottom is often marked with little furrows made by their passing from place to place. They advance with the posterior end foremost, and the decorticated beaks, seen through the water, bear a strong resemblance to the eyes of a large animal. *Deterville* says "they have been observed to live for several months of the summer in clay too hard to be cut by the hoe, and with but momentary showers to refresh them." This, if it be a fact, must rest, for the present, on his authority; as we know of no one who has confirmed it by observation.

We know but little concerning the *generation and propagation* of the species of Molluscous animals that inhabit these shells. They are generally supposed to be hermaphrodite *per se*. If they are really and absolutely so, the number of species must be exceedingly great. *M. Lamarck* supposes that they are propagated by means of a fecundating fluid emitted into the water. If so, they must be male and female. What reason he has for this supposition, we are not informed, but if it be admitted, it will readily account for the numerous varieties of these animals, and it will show also that they are merely *varieties*, and not different *species*, that is, they will prove to be the "common

* Ils se tiennent enfoncés dans la vase, ayant leur crochets tournés en bas."
—*Lam. An. S. Vertebres*, Vol. VI. page 70.

children of common parents, and as much like them as they are like each other." If the fecundating fluid, emitted by the male, be received by the female, a variety intermediate between them, will be produced. By a second propagation, by one of the parents and the intermediate, a new variety, less different from the former one, than that was from its parents, will be again produced, and so on, in an endless succession of innumerable varieties. The admission of *M. Lamarck's* supposition would confirm the thought which has frequently and very forcibly struck us, that, properly speaking, there is but *one species* of the whole *genus*; and perhaps of the whole *family*. But this subject is covered with a veil of obscurity. There is yet wanting a series of minute and well-directed observations on the habits and manners of this interesting tribe of molluscan Bivalves. In the mean time we must follow our guides at the hazard of being sometimes misled.

Brugière established the genus *Unio*, but his original observation on this subject we have not been able to find. The word signifies a *pearl*, because "many of them produce very fine pearls,"* and nearly all of them have a pearly inside called naker or mother-of-pearl. *Pliny* in his Natural Hist. Lib. IX, Cap. 35, entitled *Quomodo et ubi inveniuntur, margaritae*, uses the word, gives the reason of its derivation, and makes it constantly masculine. In this he is followed by our countryman *Mr. Say* who makes it always of the masculine gender except in that species for which he gives credit to *M. Le Sueur*. Why the celebrated and accurate *M. Lamarck*, has chosen to make it feminine, we cannot even conjecture. *Order of description*. No certain order has hitherto been adopted by Naturalists in their description of Bivalves. The descriptions both of *M. Lamarck* and *Mr. Say* are without a definite method.* Though they generally begin with the outline of the shell, yet they throw together promiscuously the other parts, both internal and external. I propose to reduce this subject to order in the following manner. In examining a bivalve, the first thing that strikes the eye of the observer is the *outside*, the second is the *inside*. Hence the description will be divided naturally into two parts, the *External* and the *Internal*. As it is by the interior that we determine the genera of the *Naiades*, as

* *M. Lamarck*.

well as of many Oceanic Bivalves, it might seem most proper to commence with that part in describing. But as the generick characters, standing at the head of the genus are supposed to be known, and are therefore not enumerated in the description, and as the method of commencing with the exterior has been generally adopted, we have not deemed it necessary to depart from the established usage. The parts are two, viz.

(A.) EXTERNAL. (B.) INTERNAL.

Each of these comprehends three divisions, viz. I, Form, II, Color, III, Surface. With sub-divisions as follows, viz.

A. EXTERNAL.

I. FORM AND SUBSTANCE includes

1. General outline or circumference.
2. Substance of the shell.
3. Disks, right and left.
4. Sides, anterior and posterior.
5. Umbones or bosses
6. Beaks.
7. Ligament.
8. Lunules, anterior and posterior.
9. Eight margins viz.
 - a. Hinge, or dorsal.
 - b. Basal.
 - c. Anterior.
 - d. Posterior.
 - e. f. Anterior, dorsal and basal.
 - g. h. Posterior, dorsal, and basal.

II. COLOR of Epidermis.

III. SURFACE.

B. INTERNAL.

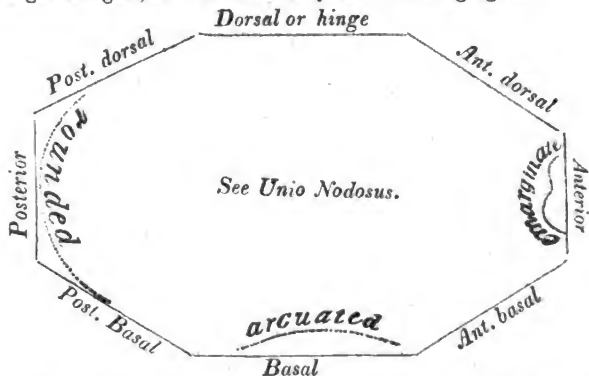
I. FORM of

1. Cardinal teeth.
2. Lateral teeth.
3. Muscular impressions, or Cicatrices.
4. Cavity of the beaks.

II. COLOR of Naker.

III. SURFACE.

The eight margins explained. Every Bivalve shell may be supposed to be circumscribed by an octagon, which will be more or less irregular, according to the shape of the shell. The eight sides of the octagon will represent the eight margins, as will be seen by the following figure.



This distribution of the circumference of the shell, tends very much to precision in the language of description, for if it be said that any particular margin is *rounded*, *arcuated* or *emarginate*, the part intended cannot be mistaken. To go into an explanation in general, of terms used in description, would carry us too far from our present purpose. We refer to *Burrow*.

We come now to the description of species of the *Unio*, which we propose to distribute into five* sections, by the form of the Cardinal teeth.

UNIO.

Generick character from *M. Lamarck*.

Shell transverse,¹ equivalve, inequilateral, free, beaks decorticated,² somewhat carious, (presque ronges) Posterior

* *M. Lamarck* makes two sections, the principal distinction of which is, *non en crête* and *en crête*, applied to the Cardinal tooth.

muscular impression compound, hinge with two³ teeth in each valve; the Cardinal one, short, irregular, simple or divided into two, substriated; the other elongated, compressed lateral, extending beneath the corselet. Ligament exterior.

1 & 2, Generally, but not always when young.

3, Others consider the divisions as separate teeth.

Divisions.

A. Cardinal teeth direct.

B. Cardinal Teeth, Oblique.

Sections.

- A. { * Cardinal teeth, very thick.
 ** Cardinal teeth, moderately thick.
 *** Cardinal teeth, small.
 B. { **** Cardinal teeth, broad, compressed.
 ***** Cardinal teeth, narrow, compressed.
 * Cardinal teeth, very thick, direct.

Species.

1. *Unio Crassus.* Fig. 1. { a. inside.
 { b. outside.

Shell very thick, tumid; Cardinal teeth, lobed, angulated; Posterior cicatrix, deep, rough.

Unio Crassus. *Mr. Say.*

Unio Crassidens. *M. Lamarck.*

Mya ponderosa? *Mr. Dillwyn p. 51.*

Mr. Say's Amer. Conch. pl. 1, fig. 8.

Habitat. The Ohio, Mississippi, and the Lakes.

Diameter 2·4 Length 3·2 Breadth 4·8 inches.

My Collection.

Shell oval, ponderous, rounded behind, angulated before; Epidermis blackish brown; surface waved. Cardinal tooth deeply sulcated; anterior cicatrix wrinkled and striated; Naker pearly white and iridescent.

Remarks.—The varieties of this shell are numerous, and they differ considerably in form and surface. In some, the beaks are large, prominent, re-curved, projecting backwards

with a deep cavity beneath. In others, the beaks are flat, slightly elevated, having only a small cavity within.

Varieties.

- (a.) Oval. Mr. Say's book, pl. 1. fig. 8.
- (b.) Ovate. Mr. S. B. Collins's collection, hab. Ohio.
- (c.) Triangular, do. do. do.
- (d.) Quadrangular. My collection.
- (e.) Orbicular. Mr. Collins's collection.
- (f.) Undulate. do. do.
- (g.) Rugose. do. do.
- (h.) Radiate. Mr. Say's collection Philadelphia, Ouisconsin.
- (i.) *Unio giganteus*. Mississippi. Dr. Mitchill's collection.
- (k.) Deeply folded. Maj. Delafield's collection.
- (l.) With the cardinal tooth oblique. Mr. Collins's collection.

Variety (c.) has the beaks projecting and recurved : cicatrices deep : primary tooth deeply sulcate ; lateral tooth long, high, and crenulate. It approaches our *Unio Undatus*.

The variety (i.) deserves particular notice. A single valve sent by Professor Douglass to Dr. Mitchill, weighs fifteen ounces. It is in every respect, a gigantic shell. The distance between the points of the two lobes of the cardinal tooth, is one inch ; the length of the lateral tooth, three inches ; diameter of the posterior cicatrix, one inch, and its depth one fourth of an inch. This shell of which four specimens were obtained by the N. W. Expedition, might perhaps constitute a separate species under the designation of *Unio Giganteus*. It is three times the size of the largest *Unio Crassus*, mentioned by Mr. Say and M. Lamarck. Three specimens.

Diam. 2·9	Length, 4·8	Breadth, 7·2 inches.
-----------	-------------	----------------------

3·0	4·6	7·0
-----	-----	-----

3·1	4·7	7·1 are preserved
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ed in Dr. Mitchill's cabinet. Another specimen

Diam. 2·9 Length, 4·9 Breadth, 7·0 and weighing fourteen ounces, is preserved in Gov. Cass's collection, Detroit. Hab. The Mississippi near Prairie du Chien. Prof. Douglass.

Variety (k.) has the Epidermis dark brownish red, and the shell is deeply folded like *U. Plicatus*. Hab. Lake Erie.

Maj. Delafield's collection.

Diam. 1·7 Length, 2·3 Breadth, 3·1

Remark.—This shell is thinner than specimens of the same size usually are.

2. *Unio Undulatus*. Fig. 2. { a. inside.
b. outside.

Shell rhombick ovate, with numerous waving folds radiating from the beaks.

Unio Peruviana ? *M. Lamarck.*

Taken by *Mr. Collins* in the Ohio and preserved in his collection.

Diam. 1.9 Length, 3.4 Breadth, 4.6

Shell thick, very short and obtusely rounded behind; beaks slightly elevated; hinge-margin sub-alated, compressed, carinated, distinct with a furrow on each side; anterior dorsal margin sub-truncate; Epidermis blackish brown; surface finely wrinkled transversely; wrinkles becoming lamellar on the anterior side; *oblique folds* deeply indenting the anterior margin; *waves* largest and deepest below, not extending to the anterior dorsal margin, fine, numerous, curved upwards, and extending to the ligament above; *longitudinal furrows* extending from the beaks to the anterior dorsal margin; decussating the oblique waves; the lowest furrow deepest, the other somewhat obsolete; disks tuberculated below the beaks. Cardinal teeth sulcated; posterior cicatrix very rough and deep; Naker pearly white, irregularly spotted with brownish green.

Remark.—A large and very beautiful shell.

3. *Unio Plicatus*. Fig. 3. $\left\{ \begin{array}{l} a. \text{ inside.} \\ b. \text{ outside.} \end{array} \right.$

Shell sub-quadrangular, tumid, sinuous before with distant oblique folds; hinge-margin elevated, compressed, carinated.

Unio plicata. *Le Sueur.* *Mr. Say.*

Unio Rariplicata. *M. Lamarck.*

Hab. Ohio, Mississippi, and Ouisconsin.

My collection. Cabinets of *Lyceum* and *Dr. Mitchell*.
Mr. Say's cabinet, Philadelphia.

Diam. .75 Length, 1.0 Breadth, 1.3 inches.

1.35	1.9	2.4
------	-----	-----

1.9	2.3	3.2
-----	-----	-----

Shell thick; posterior side very short, obtusely rounded; anterior side compressed, wedge-shaped; beaks very prominent, large rounded and projecting backwards nearly as far as the posterior side; ligament passing under the beaks, anterior lunule distinct and marked with longitudinal furrows; hinge margin alated, compressed, carinated; epidermis green, becoming blackish as the shell advances in age; surface glabrous, deeply folded; folds indenting the anterior basal edge. Cardinal teeth crenate, sulcate; posterior cicatrix rough; cavity of the beaks deep and directed backwards. Naker very white, tinged on the anterior side with rose colour; surface polished and on the fore part iridescent.

Remarks.—In young specimens the folds are visible on the inside, but in older ones the edge is not even indented. This shell very much resembles the variety (*d.*) of the *Unio Crassus*. Both shells will stand erect when placed on the posterior side, being supported by the projecting beaks. *M. Lamarck* observes that his *Rariplicata* is nearly allied to his *Peruviana*, but if we have not mistaken his short definitions, they are much more unlike than the two above mentioned. Our undulatus will not stand on the posterior side, as the beaks project very little.

4. *Unio Undatus*. Fig. 4.

{
 a. inside.
 b. outside.

b. outside.

Shell, sub-triangular, sub-longitudinal, very tumid, waved ; lateral teeth, *two* in each valve.

Unio Obliqua? *M. Lamarck.*

Hab. Ouisconsin and Fox Rivers. *Mr. Schoolcraft.*

Dr. Mitchell's cabinet. My collection. Mr. Say's collection.

Diam. 1.5 Length, 2.1 Breadth, 2.2

Shell thick, disks swelled behind; depressed before; anterior side slightly produced, rapidly narrowed, angulated; beaks projecting backward nearly as far as the posterior

side, elevated, and recurved, with the ligament passing between them; anterior lunule long-heart-shaped, and separated by a slightly elevated heel; hinge margin depressed, between the beaks; basal margin waved and rounded behind, compressed in the middle, angulated before; epidermis horn-color, exhibiting a light yellowish green where the surface is worn or rubbed, wrinkled and finely striated transversely; surface glabrous. *Cardinal teeth* deeply sulcated and crenated; *lateral teeth two in each valve!* internal or lower one of the left valve small, but distinct and elevated, and both marked with fine dotted striae. *Muscular impressions* deep, posterior one rough. *Naker* pearly white.

Remarks.—This shell, as will be seen by its dimensions, has a more globose form than perhaps any other *Unio*. It will stand erect on the posterior side, and in this position has something of a pyramidal appearance.

Variety (a.) Shell less, very slightly compressed, anterior lunule much flattened, and the separating heel more elevated. No posterior lunule; transverse wrinkles deeper; hinge bent to nearly a right angle. Teeth somewhat compressed. Naker, pink or flesh colored; surface polished and iridescent.

Diam. 1.0 Length, 1.4 Breadth, 1.6

Dr. Mitchill's Cabinet.

Remarks.—This shell differs in so many particulars from the former that we might have given it a different specific designation, had we not been averse to doing that in the case of solitary specimens. *The double lateral tooth of the left valve is distinct.*

5. *Unio Cornutus*. Fig. 5. $\left\{ \begin{array}{l} a. \text{ inside.} \\ b. \text{ outside.} \\ c. \text{ Posterior slope.} \end{array} \right.$

Shell sub-orbicular, divided longitudinally by a regular row of large, distant tubercles.

Hab. Fox River. *Schoolcraft.*

My Collection.

Diam. 1.0* Length, 1.7 Breadth, 1.8

^a Exclusive of the corps.

gin, straight with the beaks projecting above it; anterior dorsal margin rounded; anterior margin emarginate; anterior basal margin; compressed and a little shortened, basal and posterior margins rounded. *Epidermis* horn color, surface irregularly corrugated and tuberculated all over, except a small portion of the posterior side. Tubercles largest near the centre of the disks, and often eroded; a strong, elevated and nodulous ridge extending from the beaks to the anterior margin and projecting in front. *Cardinal teeth* sulcated and crenulated. *Lateral teeth* short, thick, rough, crenated and terminating abruptly at both ends. *Cavity* deep and angular admitting the end of the fore finger.

Remarks.—The breadth from the emargination to the posterior side is equal to the length of the shell. Two specimens in the Lyceum's cabinet are wrinkled regularly and beautifully across the transverse striæ on the anterior lunule, giving to that part, a feather-shaped appearance. Other specimens have the lunule wrinkled and granulated. This shell will stand on the posterior side though not quite erect, but leaning towards the hinge.

8. *Unio Tuberculatus*. Fig. 8. }

Shell, long-ovate, surface corrugated, waved tuberculated, ribbed. Disks compressed, base falcated.

Hab. Ouisconsin, Prof. Douglass.

Cabinets of Lyceum and Dr. Mitchell.

Diam.	Length,	Breadth,
·7	1·3	2·4
1·3	2·3	4·2
1·3	2·4	4·5

Shell thick and rugged; anterior side compressed, narrowed thin; posterior side rounded, short, obtuse, and broader than the interior. *Beaks* flat, placed about two ninths from the posterior end; *ligament* higher than the beaks; *hinge-margin* nearly straight, elevated, compressed and carinate before; basal margin compressed, falcated; anterior dorsal emarginate, anterior basal, projecting; anterior margin narrow and rounded. *Epidermis* dark brown or horn color. *Surface* thickly and irregularly tuberculated, tubercles elongated longitudinally; those near the base larger; an elevated ridge extending from the beaks and

projecting on the anterior basal edge; irregular profound, nodulous undulations radiating from the elevated ridge to the hinge and anterior margin. *Cardinal teeth* crenated; lateral teeth long and striated; posterior muscular impression deep, and the anterior half of it rough. *Cavity*, angular compressed, directed backward under the cardinal tooth, admitting the end of the finger. *Naker* pearly white, with irregular spots of greenish, iridescent on the fore part.

9. *Unio Rugosus*. Fig. 9.

Shell broad ovate; surface wrinkled tuberculated, ribbed, waved; disks swelled; base falcated.

Hab. Ohio. *Mr. Collins*.

Mr. Collins's Collection.

Length, 2.3 Breadth, 2.9 Diam. 1.5

Shell narrowed, compressed and thin before; short, obtuse, rounded and wider behind; *beaks* slightly elevated; ligament more elevated than the beaks; *hinge-margin* compressed, carinate; basal margin falcate, emarginate, and compressed; anterior margin sub-angulate; anterior dorsal margin sub-truncate, nearly straight; anterior, basal margin projecting. *Epidermis* dark brown, under the epidermis pearly white. *Surface* rough and scaly, wrinkled transversely and waved longitudinally, having distant irregular transversely compressed tubercles; a broad nodulous elevated somewhat double ridge extending from the beaks to the anterior basal edge, and projecting on that part; a broad furrow or wave behind the ridge ending in the emarginate basal edge; and a furrow before separating the anterior lunule; small oblique waves radiating from the ridge to the hinge and anterior dorsal margin. *Cardinal teeth* sulcated; lateral tooth striated rough and in the left valve somewhat double: Posterior muscular impression deep and partly rough. *Cavity* of the beaks angular, compressed and directed backward under the cardinal tooth. *Naker* pearly white, and on the fore part iridescent.

Remarks.—This shell agrees in some parts of its description with the *U. Tuberculatus*. It is, however, while of the same length, of only a little more than half the breadth, and yet of longer diameter. The tubercles, also are very different. In the *U. Tuberculatus* they are compressed lon-

gitudinally, in this transversely, in that they are crowded and small: in this they are distant and rather large. The elevated ridge in that is higher and narrower; in this it is broader and more depressed; in that it continues of nearly the same breadth to the base; in this it diverges at the base, to about four times its breadth at the beaks. The shell above described has the appearance of age. The tubercles, as well as the beaks are much corroded, and the epidermis is cracked and broken in many places.

Remarks on the first section, viz.

* Cardinal teeth, very thick.

To this section belong the *U. Peruviana*, *ligamentina* and *obliqua* of *M. Lamarck*, and the *U. Cylindricus?* of *Mr. Say*. The shells in this section bear in many respects, a resemblance to each other. They are all thick, and have a very strong hinge, with, in most cases, deeply sulcated cardinal teeth, and a cavity under the beaks, more or less angular and compressed, extending under the cardinal tooth. They are nearly all waved, wrinkled, or tuberculated on the outside: From the last two characters, however, some varieties of the *U. Crassus* are excepted, which have little or no cavity under the beak, and a small external surface.

It may perhaps be thought that we have made too many distinctions in this section, and that several of the foregoing ought to belong to the *U. Crassus*, but they are much more unlike than many which are admitted to be distinct species, and therefore they require a separate description. And when it is observed that we have not yet enumerated all that have been supposed to belong to the numerous family of the *Crassus*—that the ascertained varieties of that species have already been described to the number of eleven from (*a*) to (*l*) inclusive; and that among these varieties are several which *M. Lamarck* has described as different species—and that the foregoing are all very distinct from each other, so as to be instantly recognized by even an inexperienced observer—we shall perhaps be justified in discriminating the above, and several others also, which belong to the next section.

(*To be continued.*)

PHYSICS, CHEMISTRY, &c.

ART. VII—*An Essay on the formation of the Universe: by ISAAC ORR, one of the Professors in the Asylum, for the Deaf and Dumb, at Hartford, Conn.*

TO THE EDITOR.

Dear Sir,

IF it is admissible in the explanation of appearances, to adduce a theory, whose absolute and invariable characteristics are wholly coincident with fact; and whose variable characteristics admit of such a construction, as to be also coincident; and whose allowable irregularities usually exist in those appearances; the present attempt to illustrate one of the most difficult physical subjects will not want an apology, though it should eventually be numbered with other similar attempts, that have sunk with their projectors into their own oblivion. It is far from being the least difficulty, to be met by a theory, professing to account for the motion and relative position of the heavenly bodies, that such theories have been so numerous and so utterly visionary, as to stamp seeming futility on all. In view of so formidable an array of adverse public opinion, it seems sufficient to collect, arrange, and exhibit the proofs of such a theory, and leave it for others, who are not personally interested in the decision, to judge of their validity. Whatever is asserted in this memoir, although perhaps, sometimes passed over rather too briefly, can, I believe, in all cases, be amply substantiated. In several instances where it is said that assertions are demonstrable, the demonstrations are omitted, on account of their length, or comparative want of importance. They will be given hereafter, if they should be demanded. For several remarks and demonstrations, with regard to the separation into strata of a finite ocean of concreting aerial matter, when particular gravitation is supposed infinite; the construction of strata by accumulation at their edges; the diur-

nal motion of the satellites; and the relative position of the orbit of Mercury and the equator of the sun, as well as a variety of other useful suggestions, I am indebted to Mr. Fisher, the late able Professor of Mathematics and Philosophy in Yale College; and while with the remembrance of his former assistance, I mingle regret that he was not permitted privately, as he intended, to lay the following speculations before European minds powerful and acute like his own, and to aid further in rendering them more lucid and satisfactory; I cannot omit to add, that America, and the world have great reason to regret the premature and tragical death of this distinguished young man.

In the examination of the solar and the stellar systems, various phenomena occur, which are much too regular to be considered the pure effects of accident, while on the other hand, they are not sufficiently so to be attributed to the immediate operations of an intelligent designing agent. To such operations they have heretofore been attributed, solely because, on any other ground, they seemed utterly inexplicable, and the ends aimed at in their existence have been taken for granted, although the human mind could discover nothing respecting them. Of these phenomena the most obvious are,

1. The primitive parts of the earth, so far as they have been examined, are apparently the result of purely chemical precipitation. There are sufficient reasons to believe, that the quantity of water above their surface has been very greatly diminished.

2. The sun revolves on its axis, and all the planets in their orbits, in the same direction, and nearly in the same plane: and likewise all the planets that have satellites, revolve on their axes in the same direction as their satellites in their orbits, and nearly in the same plane.

3. The planets *generally* revolve on their axes in the same direction with the sun: and the satellites, so far as their diurnal motion is known, and probably in most instances, revolve on their axes in the same direction with their primaries. The most remarkable irregularities are near the sun, at the superior extreme of the sun, and probably at the orbits of the asteroids.

4. The velocity of each planet on its axis, has a *general* direct proportion to its quantity of matter, and distance from

the sun : and an inverse proportion to the number and mass of its satellites. The revolution of each satellite on its axis, and its periodical time, are probably equal.

5. The planets, taken with respect to their masses and intermediate distances, exist in two distinct series, the upper one of which gradually increases, and the lower one gradually increases and diminishes in quantity of matter as we descend toward the sun : and on the contrary, the eccentricities of the successive orbits have in the upper series a gradual diminution, and a gradual diminution and increase in the lower series. The planets of the upper series are much the largest and most distant apart. With regard to intervening distance an analogy is known to exist between the planetary and lunar systems, and there are reasons to presume that it exists also with regard to eccentricity and quantity of matter.

6. The asteroids appear to exist in pairs, two of them having atmospheres similar to each other, but much greater than the atmospheres of the other two ; and the individual of each pair which has the most oblique orbit, is in very nearly the same degree the most eccentric, and its mean distance from the sun is in a different degree the greatest.

7. The rings of Saturn are nearly in the same plane with its equator and satellites : The inner ring is much larger than the outer one, and their angular motion is a little slower than that of the planet, but much more rapid than that of a satellite at the mean distance of its parts. Saturn in contradistinction from all the other planets, and from the form which it would naturally assume if it were fluid, is considerably depressed about its equator.

8. The densities of the various planets and satellites are *generally* in inverse proportion to their quantities of matter, and in a direct proportion to their distance from the sun.

9. Comets move indiscriminately and almost equally in all directions. The perihelia of all of them are between the sun and the orbit of Jupiter ; and the orbits of the intervening planets are, with regard to their obliquity, the most irregular.

10. The stars are not uniformly scattered over the firmament, but appear in nebulae, which are generally arranged into strata, and run on to a great length. Some of these strata appear parallel to each other, and some in the shape

of a fan. With the exception of these strata, and numerous subordinate circular collections, the figures of the various clusters seem to be wholly fortuitous.

If the primitive rocks were precipitated from water, the precipitation, according to all our experience on the subject, must have been gradual. At the time of such precipitation the earth must have had a diurnal motion, because it evidently partakes of the spheroidal form derived from such motion, far below the general level of any rocks with which we are acquainted. This motion, in connexion with the influence of the other bodies in the system, would produce a disturbance in the water around the earth, similar to what the tides now exhibit, but much greater in degree. The unavoidable inequalities in the surface of the accumulating rocks, would subject them, at least in some degree, to trituration at the prominent parts, and to alluvial deposits in the cavities. But no such deposits can be found. Besides, from our knowledge of their constituent parts, we have every reason to conclude, that many of them are not at all soluble in water, whereas by heat and electricity they can all be dissipated. There is, therefore, at least good reason to presume, that by these and other elastic agents they were once separated, and came together either partially by the aid of water, or wholly without it.

In the process of the argument it will be necessary to take several things for granted, of which the proof is cumulative, or most appropriate in another place. Suppose the component particles of the matter in the solar system to have never come together, but to be mixed indiscriminately, and distributed by means of light and heat, in a flat spheroid, having its greatest diameter some millions of miles longer than that of Herschel's orbit, and revolving with such rapidity as to throw off portions from its circumference. As the heat and light abandoned it, its various parts would condense either by explosion or sudden combustion, according to the different forces of attraction among their component particles. Suppose that by some means or other its motion should be increased to such a degree, that by the time it had shrunk to about midway between the orbits of Saturn and Herschel, it would have thrown off from its circumference as much matter as is contained in Herschel and its satellites. Suppose that its motion should be still in-

creased, so that by the time its circumference had arrived about midway between the orbits of Saturn and Jupiter, it would have thrown off as much matter as is contained in Saturn and its satellites. Make the same supposition for Jupiter, and so successively for all the planets below Jupiter. This ejected matter, unless the cause of motion were variable in its direction, would be left moving nearly in the same plane. Having lost its equilibrium the mutual attraction of its parts would unavoidably draw it together. It would first collect into small bodies, and these into greater. As soon as reaction took place at the centre of a body, unless the matter were perfectly dense, there is an infinity of chances against one, that it would commence a circular motion similar in some degree to that of eddies and of whirlwinds. The circular motion of whirlwinds is produced by air proceeding, while unresisted, in a direct course towards a central line. In a condensing insulated body the circular motion would be produced by the force of the matter proceeding in a direct course towards a central point. This motion would recede from the centre no faster than the reaction between the central wheels, and the aerial matter collecting towards it. When the central wheel had commenced its motion, the collecting matter would proceed, not all the way in a direct course towards its centre, but in curved lines eventually becoming tangents to its circumference. This curved direction would be produced by friction among the extreme concentric strata of the wheel, whose great rarity would render the deviation very gradual. There are cases with which we are familiar, where the motion of non elastic matter would be annihilated, while that of elastic matter is almost wholly retained; and it seems in the case before us, as if the matter would be turned into a circular course without any very great loss in its acquired rectilinear motion. As the matter accumulated on the central wheel, there would be a constant increase of compression throughout the whole, which would be always least at the surface and centre, and greatest at some point between them; and from the centre this point would constantly recede. For at the extreme circumference, or the place where the matter commenced a curvilinear motion, there would be no increase of compression; and the strata near the centre having the same increase of weight or pressure

upon them as the higher strata, and having on account of their greater *degree* of compression, a greater power of resistance, the spaces which they occupied would not be so much reduced in a given time, as the spaces of the higher strata. By this increase of compression the matter which at any one moment seemed in equilibrium, would continually advance toward the centre, and retaining the same actual velocity, its angular velocity would be increased, and the increase of angular velocity would be constantly transmitted from the whole wheel toward the circumference; in the greatest degree from the point of the greatest increase of compression, and from all parts in a degree proportioned in some measure to their distance from that point. Here we perceive a double and nearly contemporaneous source of increase in the angular velocity at the circumference; the force of the falling matter, and the increase in the compression of the central wheel. The action of the falling matter would be immediate: the effect of the consequent compression would instantly commence, but would be rather more dilatory in their termination. There is another compound source of angular velocity considerably similar to this, but much less in degree and in the rapidity of its operation. According to the known properties of matter, considerable portions of the aerial wheel would concrete by instant explosion or sudden combustion, into a densely fluid or plastic state, and would proceed towards the centre of the wheel, and there form a nucleus, which being aided in the commencement of its motion by the aerial part of the wheel, would revolve in the same direction. With regard to these condensed portions of the wheel, there are two difficulties to be obviated; the resistance which they would meet in proceeding to the central nucleus, and their liability to strike it in a direction differing from a tangent to its circumference. With respect to the first we may suppose, that the density of the aerial and condensed matter might be very greatly different; and the supposition is perfectly consonant with our experience. The cohesion of the falling bodies might be so great as to prevent their being dissipated, while at the same time their fluid or plastic state would enable them to assume all the length of form which is necessary to reduce their resistance to its smallest degree. The other difficulty is no less easily obviated, for the state of the case renders it

necessary that the condensed parts, most remote, should by the motion of the aerial parts, be most turned out of a direct course towards the centre of the nucleus; and the supposition is perfectly reasonable, that the deviation might be so regulated, that all, or nearly all of the condensed bodies would strike the central nucleus in a tangent to its circumference. By the expulsion of heat and light a compression would take place in the nucleus a little different from that in the aerial part of the wheel, but the same in effect. The various portions of the nucleus, having acquired a degree of actual velocity, would merely by their approach to the centre, increase the angular velocity of the nucleus. It is obvious that the motion derived from this complex source in the nucleus, would not stop at its surface, but would be constantly conveyed by means of friction between the concentric strata, to the extreme circumference of the aerial wheel, till the angular velocity become uniform throughout. While this complex process was going on in the planetary wheel, it would collect a belt of the ejected matter from all parts of its orbit, whose width would depend on the extent of that orbit, or the quantity of matter ejected within given limits from the solar wheel, and likewise in some degree on the rapidity of condensation. Great extent of orbit, great quantities of matter ejected within given limits, and rapid contraction in the solar wheel, would tend proportionally to increase the width of the belt; while rapid contraction in the planetary wheel would tend to diminish it. It is obvious that all the causes favourable to great width of belt, except slow contraction in the planetary wheel, would belong peculiarly to the higher planets. If the planetary wheel should acquire sufficient magnitude and motion, it would in its turn eject portions from its circumference, in the same manner as the solar wheel, and these portions would form its satellites.

The motion of the planets and satellites, both on their axes and in their orbits, would be *generally* in the same direction with each other, and with the equator of the sun. Suppose P, fig. 1*, an accumulating planetary wheel, at the same distance from the solar wheel as b. A body at b would be equally liable to fall to the right or left towards P, and of course the whole of the matter in the same circle as b, would leave the direction of P's diurnal motion doubtful. But as the solar wheel shrunk from P, its emitted portions

* See Plate at the end.

would be more and more rapid, both in their angular and real velocity. Therefore a body at r would strike P before, and the general tendency of the matter in the vicinity of P would be to commence its motion the wrong way. It is necessary then to find some force sufficient to reverse the motion. Suppose a body at m has an excess of velocity above that of P , a little greater than what it would acquire in falling to m , from a point a little above the point nearest to b , in the circle of m 's emission : it would evidently rise and fall to the right. As the body is supposed to start from points nearer and nearer to the centre of S , it would trace out the curved line $b n$ of projectile separation ; till the difference of angular velocity between P and the supposed body, would be equal to the velocity acquired in falling from near b to n , and then all the ejected matter on the left side of S would pass over to the right towards P , or not pass at all towards it. It is evident that all this excess of matter passing to the right, would strike P or its outer hemisphere, on account of its tendency to continue in a right line, and of course the motion of P on its axis, would be *generally* in the same direction as in its orbit ; and if P should produce any satellites, they also, both on their axes and in their orbits, would revolve in the same direction. It will doubtless be observed, that this, as well as the other demonstrations, shews a want of exactness, which leaves the mind somewhat dissatisfied ; but it will also be observed, that as it aims only to prove general truths, because no others are necessary, so it enables the mind to perceive those truths with the utmost certainty. The first in the series of planetary wheels would obviously be most liable to derangement in its equator, because there would be nothing above it to aid in regulating its position, whereas all the succeeding ones would be more and more influenced by the solar wheel, and would also be influenced by the planetary wheels above : so that the plane of their equator would on that account be more likely to approach the plane of the solar equator.

It may be objected to this mode of formation, that it would require an immense quantity of heat and light, which would be of no use but merely to aid in forming the system, while the energies of an intelligent spirit might supply its place as well, and prevent this profusion of materials. But it appears to be by no means certain, that such an abundance

of heat and light would afterwards be useless. The heat by a general diffusion might maintain the system in a mild temperature for an immense length of time after its internal heat was almost exhausted; and the light by its being very slightly latent on account of its abundance, might enable an acute organ to observe surrounding objects by the smallest motion of the atmosphere, after the system was enveloped in darkness; in the same manner as we now see the dashing of the waves, or the motion of meteoric rocks in the sky. In a metaphysical point of view, there is no reason why the system might not have been formed by the immediate agency of an intelligent spirit, as well as by the agency of light and heat; but there are phenomena actually existing which are perfectly consistent with its formation by light and heat, but which on the supposition that it was formed by the immediate agency of an intelligent spirit, are utterly inexplicable. The relative diurnal motion of the various bodies in the system, present not the most distant indications of design; and yet they are about such as they must be, on the supposition that the system was produced by condensation from an aerial state. These motions in case of such a formation, would be proportionally increased by magnitude of orbit, and quantity of matter, and diminished by the mass, number, and distance of the satellites. Saturn's diurnal motion is not quite so rapid as that of Jupiter; its orbit is much larger, but its mass is less, and its ring and satellites are heavier and extend to a greater distance than those of Jupiter. Mars is less than the earth, but its orbit is greater, and it has no moon: its diurnal motion is a little slower than that of the earth. Venus is about equal in size to the earth, and it has no moon, but its orbit is less than that of the earth: their diurnal motions are about equal. The orbit of Mercury and its quantity of matter are much less than those of Venus; and so is its diurnal motion. The moon to acquire its present velocity, must have fallen to its present distance from its primary, through a space about equal to $\frac{1}{7\frac{1}{2}}$ of the diameter of the orbit of its primary; the highest satellite of Jupiter through $\frac{1}{7\frac{1}{2}}$; and the highest of Saturn through $\frac{1}{7\frac{1}{2}}$. It may be remarked with regard to all the satellites, that if they acquired no motion at all by the collection of their parts, they would notwithstanding have a diurnal revolution exactly coinciding with their revolution round their primaries: and if

by collection they acquired a very considerable degree of motion round their axes, their constituent wheels would immediately assume a shape elongated on a line drawn through them from their primaries, and would tend to remain in this position; so that however great the velocity of the internal parts might be, it would be continually diminished by friction proceeding from the exterior, till the wheel became stationary on the abovementioned line, or the whole became solid.

Multiplying the width of the rings of ejected matter which it is reasonable to suppose was about taken up by each of the planetary wheels, into the length of their orbit; and dividing its comparative quantity of matter by this product, we shall obtain the proportionate average quantities of matter ejected in a given space from the solar wheel, through the various steps of its progress. The result gives for Herschel 0,093, Saturn 1,552, Jupiter 14,812, Pallas 0,075, Ceres 0,054, Juno 0,016, Vesta 0,010, Mars 0,086, the earth and moon 2,946, Venus 4,357, Mercury 1,490. From the state of the case the calculations are unavoidably loose; but if we vary the premises within any rational limits whatever, the same general result is inevitable. If the two sources of emission described above, were regular in their increase and diminution; and if the ejected matter composing the two series of planets, instead of collecting together, be supposed to remain at the same distance from the common centre at which it was emitted, and to be distributed in two concentric rings of equal density, a section of these rings by a perpendicular plane passing through the common centre, would be lenticular, having the widest parts nearer the inner than the outer extremes. If we take the quantity of matter included between two such sections meeting at S, fig. 2, and suppose the velocity of each part to be the same that it had when separated from the solar wheel, the parts from m to a, and from n to S, would be *nearly* in the shape of a pyramid; and from e to m, and from a to n, in the shape of a wedge. In the part J, the centre of its gravity, or the place where the whole of that part would meet in case of condensation, would be about g, near its base; whereas the point of average velocity, on the point where the matter should meet to move with the same velocity as the portions there emitted from the solar wheel, that is, to move in a circular orbit,

would be about v , nearer the vertex. In the part H , those points would obviously be reversed, so that somewhere between the parts J and H , they must coincide. What would hold true of such a portion of the ring, would, in respect of gravity and velocity, be true of the whole. Planets formed at the place where these points coincide, would move in circular orbits; and the excentricities in the various orbits would have a general proportion to their distance from the place of coincidence. This is the case with the excentricities in the solar system. The cause of emission being much more rapid and powerful in its operation, and the orbits being larger in the upper than the lower series, the planetary wheel in the upper series, as was shown above, would of course be the largest.

Between the upper and the lower series of planets there is a large space, where the quantity of matter thrown off from the solar wheel must have been comparatively small. Suppose that two distinct bodies were formed in the same circle of this diminutive portion of the great belt, at opposite sides of the circumference. Many such bodies of a smaller size must of necessity be formed, and must proceed to meet and combine with the one that commenced the formation, and had acquired a superior influence above the rest. Those which came in last would of course be the largest: and it is perfectly reasonable to suppose, that the last of all might be nearly equal to the principal one. The smaller body in proportion to its inferiority to the larger one, would have a tendency to strike it on its higher hemisphere, or the one most distant from the solar wheel. If it should strike the larger one so far up as to bound off from it, the smaller one would obviously be thrown in a direction diverging from its natural course, and from the solar wheel. If the smaller body should strike the larger one on its posterior hemisphere, the original motion, or the motion which it had when thrown off from the solar wheel, would be accelerated and that of the larger one retarded. But if the smaller should strike the larger one on its anterior hemisphere, the original motion of the larger one would be accelerated, and that of the smaller one retarded. This is evident from the fact, that the force of percussion could not have so great an influence to accelerate or retard their motion, as the force of their mutual attraction prior to percussion, or else they would remain together. Here then we find three causes of eccen-

tricity ; the general one arising from the difference in the rapidity of emission ; the change of direction by percussion, and the change of velocity by the same cause. But the cause of the obliquity of their orbits is one, and therefore renders that obliquity a surer basis of calculation. If the point of percussion were not in the plane of the equator of the solar wheel, the two bodies would evidently be thrown out of that plane, and the relative obliquities of the two bodies in each pair, would at least approach an inverse proportion to their quantities of matter. With regard to the coincidence among their nodes and perihelia, it may be remarked, that the greater asteroid of the lower pair would, in all probability, commence its formation near the greater one of the higher pair ; and likewise the smaller one of the lower pair near the smaller one of the higher. This would obviously be true on the very probable supposition that not a very long space of time intervened between the formation of the upper and the lower pair. The same remark may be extended to the other planets ; for it is obvious, that on account of mutual attraction, each planet would commence its formation as near as possible to the one next above it. It may also be remarked, that the smaller asteroid of each pair would take the direct course towards the greater one, and of course immediately after percussion, it would have the most rapid motion, and eventually the largest orbit. On this subject a close inspection of the demonstration respecting the rotary motion of the system, will be conclusive. In this respect theory agrees with the actual state of the asteroids. The explosive theory proposed by Dr. Olbers, is indeed practicable : but if the asteroids had been separated from a solid planet, they would still float through the heavens, the obvious fragments of spheres ; and if they had been separated from a pulverulent or plastic or fluid planet, they would have been driven into a multitude of parts, unless the planet had been thoroughly divided by regular and uniform strata of the exploding substance, a most wonderful device in an omnipotent Creator to split a planet, and make its parts move irregularly. But it would seem as if the circumstance alone respecting the atmosphere might put the subject at rest.

The ring of Saturn, while in its present situation with regard to the planet, could never have been in a state wholly

fluid or aerial; for, being destitute of an equilibrium, the mutual attraction of its parts would immediately have reduced it to a spherical figure. But suppose the matter contained in Saturn and its ring, when condensing from an aerial state, had been retained by the force of its satellites, in the form of a flat spheroid; it would gradually stiffen by the expulsion of light and heat, and most rapidly at the edge on account of its tenuity. Eventually the edge, by reason of its greater increase of density, and excess of velocity above what would keep a satellite at its distance from the centre, would be abandoned by the interior part of the wheel, and form a ring around it. The slender edge of the planet, as soon as released from its connexion with the ring, would fall into the planet, and inevitably produce a depression about its equator. The planet being in a plastic state, could not restore itself to the form which it would naturally assume if it were fluid; so that it must still remain at least in some degree depressed about its equator. Such is Saturn's form in reality. Astronomers have accounted for the forms of all the other bodies in the system, by the principles of gravitation. This stands a single anomaly, and by all the principles of gravitation and motion in which it is now concerned, it is wholly inexplicable. If we suppose half the quantity of matter contained in the ring of Saturn to be solid, and perfectly regular, and the other half to be fluid, the fluid parts having an attraction for each other, the lateral perpendicular action of the solid part could do nothing to prevent accumulations from commencing, and when they had once commenced, they would unavoidably continue, till the whole would be collected together; and the most of the solid part, being much more distant from the fluid parts, than the fluid parts from each other, its comparative action would of course be feeble. From this example it is easy for the mind to perceive, that however small the fluid part might be, it would have a similar tendency to accumulate in a degree proportioned to its quantity. If the ring, after its formation, remained entirely regular, the least bias possible, as La Place has shown, would destroy its balance, and it would be certainly and inseparably attached to the planet. For if the planet *P*, fig. 3, receive a bias toward the parts of the regular concentric ring *m n r s*, the parts *m*, *n*, *r*, having the same force as *s*, could not by revolving change the

direction of P's motion, which would be continued toward the stationary point at s, because toward that point the force would be instantly and constantly increased, while toward that at m it would be in like manner diminished. But if the part of the ring at s were considerably more massive than the other parts, then as s passed round, P would incline to follow it: but s constantly changing the direction of its force on P, would tend to draw it from its original direction; while the momentum, acquired by P, would tend to continue it in that direction; and P would eventually move in a small orbit within the ring. For sometime after the commencement of P's motion, s would act upon it in some chord of P's orbit. The direction of its action would continually move toward the centre of motion, till it arrived at it, and there it would stop; and the centre of motion would coincide with the centre of gravity. For P having acquired its greatest possible motion, and that of s being reduced to its least degree, s would have no tendency to vibrate to the other side, and of course could not draw P backward in its orbit. The same reasoning will apply to the sun and planets, and to the primary planets and their satellites, and the general centres of motion and of gravity, in every case that has been assumed in explaining the formation of the system, would in like manner be adjusted. The account which Dr. Robison has given of the formation of Saturn's ring, is incomparably more natural than the explosive theory of the asteroid. Notwithstanding, there appears to be considerable difficulty attending it. The form which glass assumes, by whirling when in a viscid state, gives it a very considerable degree of plausibility; but the mutual attraction between the parts of a small glass plate must be very trifling compared with that in the ring of Saturn, so that the analogy is very incomplete. The distance between the limits of the smaller and greater spheroids, which may be produced in the same body of fluid or aerial matter, by the same angular velocity, is very great; and the body while passing between these limits could not maintain an equilibrium. Its parts must of course while passing through the whole of that distance tend to collect together irregularly. Besides, a whirling plate of glass is thicker at the circumference, than at the parts between the centre and circumference; so that the analogy, imperfect as it is, militates against the theory. But if the case were attended with no difficulty, Dr. Robison has, at least in some degree, gone

counter to one of the laws of investigation laid down by Newton; by assigning causes more than sufficient to produce the effects in question; for it would obviously be as easy for the Deity to create a body of whirling viscid matter in the greater as in the smaller spheroid; and then the process of driving it out from the centre would be unnecessary. This is only taking a wide step toward the theory of condensation from an aerial state; for it would be just as easy for the Deity to create whirling spheroids of aerial, as of plastic or fluid matter, and then a mechanism for the motion of the satellites is contrived, as well as for that of the ring.

To account for the relative densities of the various bodies in the system, seems at first beyond the grasp of the theory, because we cannot inspect the interior even of our own planet, much less can we that of the rest. But it is a well known fact that all large bodies of condensing homogeneous substances, stiffen first on the out side; and the supposition is perfectly reasonable; that the bodies of the solar system might so stiffen near their surface, while the interior remained very much heated and expanded. Beneath this crust, the interior parts would collect and condense upon it, as water on the lower surface of ice, until it became strong enough to support itself by its own density. It would then cease to sink any further toward the centre, and the remaining fluid or viscid parts of the body, as the heat gradually abandoned them, would shrink so as to form immense caverns, or would collect together on a central globe, which might eventually become entirely disunited with the external shell. In such a case it is easy to see, that it would first be disunited from the poles of the external shell, because they would cool most rapidly on account of their distance from the great solar fire, and the obliquity of the rays from that fire, which aided in continuing their heat. It would then gradually be detached from the equator of the shell, till it adhered only at a single point; and eventually, if it separated from the whole, and its centrifugal force from the common centre of gravity of the two parts, were, by disturbance, in the least diminished, it is rigidly demonstrable, that the internal globe would immediately move toward one of the poles of the external shell, and there is an infinity of chances against one, that it would change both the direction and degree of its diurnal velocity. The inter-

nal globe also would have a tendency to form the external fluids of the shell into an oval figure, which would be most raised at the place where the internal globe was situated, so that whenever this globe changed its situation, the situation of the external water would also be changed. This is probably the best account of the deluge, that it is possible to give. The comparative density of the bodies in the system, would depend on their nearness to the central fire; their magnitude; and their liability to be disturbed during formation. The bodies most distant from the central fire would cool most rapidly, and their permanent external shell would be formed while the interior remains much more heated and expanded than if they had been nearer it. Also large bodies would stiffen on the outside while their interior remained more expanded, than the interior of smaller bodies at the same distance from the sun; and therefore their density would be less in proportion to their magnitude. Bodies subject to disturbance, would of course have their shells broken up, when if they had been free from disturbance those shells would have remained permanent. Disturbance, therefore, would increase the density. It is needless to remark, that so far as we know the relative densities of the system, with this theory they are perfectly coincident.

The motion in the great solar aerial wheel, assumed at the commencement, has not yet been accounted for: but by an inspection of the argument respecting the motion of the planetary wheels, it will be seen, that the assumed motion of the solar wheel might have been produced in the same manner. All that is necessary, is to suppose, that the matter in the system was diffused equally through a space extending to an immense distance, perhaps half way to the nearest fixed stars; and it is worthy of remark, that the power of gravitation would bring the whole to the centre very nearly in the same period of time: a circumstance without which, the formation of the system as explained above, could not have been effected. The great length of this period, probably about 28,000,000 years, seems at first a very considerable objection to the theory: but when the vast resources of eternity are opened to view, and when it is considered, that the matter might as well be moving during that period, as to be at rest or not in existence, the ob-

jection cannot be deemed insuperable. The comets may be supposed to have been formed from the lingering portions, that did not come in soon enough to be combined with the system; and with this supposition their characteristics perfectly agree. They would be liable to come equally from all directions, and their elliptic orbits must have been produced principally by percussion on the solar wheel. Agreeably to this, the planes of the planetary orbits about the perihelia of the comets, are the most irregular. The plane of Mercury's orbit and that of the solar equator make nearly the same angle with the ecliptic, and it is reasonable to conclude, from the motion of Mercury's nodes, that at the time the system may have come into existence according to the theory, the plane of Mercury's orbit about coincided with that of the solar equator.

If the matter in the solar system has once been diffused about half way to the nearest fixed stars, there is good reason to believe, that the milky way at least, and perhaps the whole or a great portion of the universe, was at that time in one vast aerial ocean; and that it began to separate and form into clustres and systems, as soon as it was created, on account of an immediate tendency to such a result; or that it remained in a quiescent state for some time at least, till by the arrival of a disturbing force, such a result was effected. It is a well known fact, that the component particles of matter *may* be in such a state, as to remain separate while quiet, when the least disturbance would produce instant concretion. Keeping this in mind, it will be easily seen, that if the ocean of matter were finite, and so created that it would concrete without a disturbing force, the concretion would commence throughout all parts at once, and the collective forms of the clusters must be principally or wholly accidental, if we except the tendency which they *might* have, to become spherical: For though a regular principle of formation into parallel strata, would proceed from the exterior through the interior, in case the inner stars in the mean time remained perfectly stationary; yet on account of its dilatory progress, most of the ocean of stars, if left to unrestrained mutual attraction, would have acquired accidental forms too decided to be broken up by so weak a regulating force. But if the finite ocean required a disturbing force to effect its concretion, it would evidently begin to

concrete on the outside only, and on all sides at once. Influenced by the attraction of the interior, the parts near the outer surface would proceed towards it; and when sufficiently accumulated, if particular gravitation were finite, that is, the gravitating power of a definite body of matter, it is rigidly demonstrable, that under given circumstances it would produce a far distant disruption in the aerial ocean, somewhere about the limit of the particular gravitation of the exterior. The demonstration will not at present be given; but it will perhaps be sufficient to remark, that if the particles of aerial matter were held together by a force merely sufficient to prevent their disunion; by the arrival of forces which had not acted upon them before, that is, the particular gravitating forces of the approaching surface of the aerial ocean, such a disunion would then be inevitable. At the place of disruption, the two surfaces would separate with the greater force as their distance increased: the separating stratum would break up into systems, and the new formed surface of the ocean would advance toward the interior as before. If the ocean were sufficiently large, the strata would have a constant tendency to regularity; for

if they were crooked as $\frac{a \quad b \quad c}{\dots}$ the parts about a and c

would continually retard those at b, till the strata approached very near to a regular figure. If the ocean were infinite, and of such a nature as to concrete without a disturbing force, its formation into worlds would of course be simultaneous throughout, and the collective forms would be wholly and inevitably accidental, without any immediate or subsequent law whatever to effect regularity. If the ocean were infinite, and if particular gravitation were not infinite, there appear to be two *possible* modes, in which the formation might be effected. The strata, as accident made them so, might be flat, prismatic, and cylindrical, formed by accumulations at their ends, and continued in a direction parallel to each other, and to the course of progress. These nebulae, having the greatest power of attraction at their ends, would continue generally in a rectilinear direction; for if it were otherwise, they would indicate a tendency to accumulate at the sides rather than the edges. It is obvious from celestial appearances, that such has not been the actual mode of for-

mation. Under the last mentioned conditions, only one other mode of formation is possible. It might take place in plane parallel strata, perpendicular to the course of progress, in the same manner as in the finite ocean, where a disturbing force was required; and it is alike obvious in both cases, that the strata would be regular. With this latter hypothesis the structure of the heavens appears to agree. The fanshaped arrangement of strata, mentioned by Dr. Herschel, may appear at first to indicate the contrary; but a moment's reflection on the principles of perspective will show, that these strata may, notwithstanding, be parallel. We are accustomed to find a correspondence between the power and the operations of a wise moral agent; and it is certainly no weak argument in favour of an infinite universe, that a finite one would fall infinitely short of the power of the Deity. It would leave his angelic subjects without any practical proof of his complete omnipotence. It seems also the most consistent and exalted conception respecting a wise moral agent, that his work is never terminated, and that the power which he possesses is for ever exerted. From reasoning *a priori*, then, it seems a very natural conclusion, that each act of creative power is expanded through an infinite plane, and that the successive acts form an eternal series. If this idea appears too grand, let it be remembered that it is formed respecting the works of the Deity. Metaphysical reasoning, however, is not the only ground on which our opinions on this subject may be founded. We see the celestial systems arranged into forms which are utterly unaccountable, unless their formation has been progressive. The account which Dr. Herschel has given, is only placing one difficulty on the shoulders of another: for it is not less impracticable to account for the position of those ruling luminaries, which he supposes may have marshalled the starry hosts of smaller magnitude, into their present regular arrangement, than to account for that arrangement without such assistance. If the formation into systems has been progressive, we are perfectly at a loss to say where it began, or where it will terminate. By far, the most natural supposition, is, that it will have no termination, and had no commencement. If the universe is finite, it is obvious, that without a constant miracle, of which we find not the least indication, so far as observation

can carry us, it cannot be permanent, till the whole is collected together in one vast mass at the common centre of gravity. In like manner, if the creation of matter from nothing, constantly preceded its formation into worlds, a constant miracle would be necessary to prevent them from forever approaching each other, by gravitation from empty space towards the boundless ocean of worlds already created. If we suppose that matter has been eternal, and still perfectly dependent on the Deity for its existence and its properties, and that on one side of the infinite progressive plane of formation, it is in a quiescent ærial state, and on the other side collected into worlds, nature obtains a balance, and unless particular gravitation is absolutely infinite, the ultimate systems must be permanent: and our minds instead of being lost in a chaos of conjecture, form the same conceptions of order, through the boundless fields of space, that we derive from observation on the portions which are within our view. These opinions will undoubtedly be adverse to the belief of many with regard to the meaning of scripture; but whether they are opposed to its real meaning, is a question of quite a different character. The contests and the results respecting the Copernican system, cannot be forgotten. If such opinions are clearly and decidedly contrary to the meaning of scripture, it would be madness and disgrace as well as impiety and ruin to harbor them. The floods of sophisticated argument by which scripture has been assailed, have successively subsided without doing any thing more than to clear away the little obstructions to the perception of its immobility, and to demonstrate to the world, that its destiny is to break, and not to be broken. Though the theory is the solution of the problem for which atheists, from time immemorial have been seeking, and though it may induce perverse and superficial minds to inquire, "Where is the promise of his coming? for since the fathers fell asleep, all things remain as they were from the beginning of the creation;" yet on the other hand it carries design through the whole of the universe, and stamps intelligence on all its departments. Should it be asked why comets fly through the system to threaten ruin on its regular subordinates; and mountains lift their barren and inclement heads only to frown on surrounding fertility; the answer is ready. They are the impalpable dust on an exquisite piece of watch work;

mere grains of sand, in the corners of an immense and majestic edifice. It appears from the observations of Dr. Herschel, that most, or all of the stars are collecting into subordinate spherical clusters, and forming what he calls, "the chemical laboratories of the Universe." The principles of gravitation will bring the stars in each individual of these clusters to their common centre of gravity, in about the same period of time; and their appearance argue, that such will be the result in reality. The universe, then, was not intended to be perfect in its present state: but its various constituent parts are adapted and destined to happier and more sublime realities. It is the shoot just springing from the acorn, and pushing its way through the hardy soil, to a nobler existence:—a soil not particularly adapted to the tenderness of the youthful twig, but to the magnitude and vigor of the princely oak. It is an infant struggling in its cradle, whose mighty and majestic manhood no troubles or convulsions shall weaken; over whose immortal perfections death and destruction shall never prevail. The astronomer, as well as the prophet, has declared, that its various parts are advancing to the final conflagration, when the elements shall melt with fervent heat; when the heavens shall pass away as a scroll; and a new heaven and a new earth shall arise to a perfect and an endless existence.

Through the kindness of the Hon. Mr. Bowditch of Salem, I received, a day or two ago, an extract from the fourth edition of *La Place's Système du Monde*, which he marked and permitted to be copied. From that, I learn that in the foregoing speculations I have been anticipated; a circumstance, of which I was before entirely ignorant. It immediately struck me that it would be useless, and perhaps improper to publish them. But on close examination and comparison, there appeared sufficient reasons to change that opinion. It is but justice to myself to say, that prior to the receipt of that extract, I received no hints on the subject from any source whatever, which I can now remember, except from the letters of Mr. Fisher, which are now in my hands; Ree's and the *Edinburgh Encyclopedia*. Dwight's *Theology*: some papers of Dr. Herschel in the *Philosophical Transactions*; Bakewell's *Geology*; Cuvier's *Theory of the Earth*, and the common class books of our schools and colleges. Still, the mere fact, that the thoughts are ori-

ginal, would not be a sufficient apology for publishing what was published before, were it not, that more than half which I have written, and which cannot well be separated from the rest, is not to be found in the writings of La Place. As Mr. Bowditch, from such an examination as the time permitted, judged La Place's and my own theory to be in substance the same, and as in some of their principal characteristics they are so in reality, it seems proper to point out where they differ. La Place's mode of explaining the sources of motion in the system, is almost entirely dissimilar. So far is he from showing or even supposing them at all regular in their operation, the tenor of his remark evinces, that he considered them otherwise; he has asserted that the planets would move in the same direction on their axes as in their orbits; but his illustration is totally distinct and diverse from mine. The conditions which he has assumed *might* take place in cases where the condensation of the primary wheel was extremely rapid: in cases of slower condensation my own must be substituted. To the two distinct series of planets; to the regular course of their eccentricity; to the causes of their relative difference in density; to the causes of their relative degrees of diurnal velocity; to the causes of the obliquity and eccentricity of the orbits of the asteroids; to the cause of the depression about Saturn's equator; and to the cause of the regular parallel arrangement of the stellar strata, and the plausibility, or perhaps probability of an eternally progressive formation into worlds, as well as a variety of less important particulars, he has in no instance alluded.

With high respect,

Your obedient servant,

ISAAC ORR.

Hartford, Nov. 9th, 1822.

ART. VIII.—*On the formation of cyanogene or prussine, in some chemical processes not heretofore noticed: by JAMES CUTBUSH, A. S. U. S. A. Acting Professor of Chemistry and Mineralogy, in the U. S. Military Academy at West Point.*

In 1815, Gay Lussac, the able experimental associate of Thenard, discovered the gaseous compound called cyanogene, which, from its constituent parts, is also called carburet of

azote, and more lately Dr. Ure has denominated it prussine. We know that cyanogene is usually obtained from the cyanuret of mercury, by heating it in a glass tube, and that it is susceptible of combining with several substances, forming peculiar acids; of these, the hydrocyanic (prussic) and ferrocyanic, are the most prominent and important. The combination of cyanogene with hydrogen affords a triple preparation, distinct from that which has been called the ferrocyanic acid; for it is known, that prussic acid, *as such* does not unite with oxyd of iron, as heretofore supposed, to form Prussian blue, but only a compound of cyanogene and iron, and consequently the cyanogene is changed into a new acid, the ferro-cyanic. It is admitted, nevertheless, that the ferro-prussic acid still retains a portion of hydrogen. The hydrocyanic acid may be obtained, however, from the ferrocyanite of iron, and by distilling the cyanuret of mercury with muriatic acid; but then we separate all the iron from the cyanogene, or decompose the ferro-cyanic acid in the first instance, and in both cases the cyanogene combines with hydrogen, forming hydro-cyanic acid. The cyanuret, cyanides, and cyanidides are synonymous terms. We must suppose, when we admit the formation of an acid, that cyanogene unites with the *particular* substance that changes its character and properties, or acidifies it; hence its union with hydrogen forms one acid, with chlorine another, with iron a third and with sulphur a fourth, possessing respectively distinct properties. Can we admit, however, that hydrogen is a *constant* ingredient? That we form mere compounds of cyanogene with a base, constituting cyanides, or prussides, in a variety of instances, as when we calcine blood, bones, horns, &c. with potash, is obvious; and we are disposed to believe, that the putrefaction of animal and vegetable matter, under particular circumstances, often generates cyanogene, and probably some of its compounds, as with hydrogen, which, in the character of highly deleterious miasmata may operate powerfully on the animal economy, and produce malignant bilious fevers. Miasmata of a particular kind it is known, cause intermittent and other fevers; and the whole theory of *dis-infecting* air, as with Morveau's preparation, or chlorine gas, is nothing more than the decomposition of such miasmata, and in all probability the separation of *hydrogen from its combination*, the chlorine changing to the state of

hydrochloric, or muriatic acid. I believe it will be found, that, that compound (carburet of azote) is the *basis* of the miasmata, which produce malignant bilious diseases; and it is equally certain, that *similar causes, acting under like circumstances* will generate it in the cities of New-York, Philadelphia, or Baltimore, as in the West-Indies. We admit, as in the formation of nitric acid in artificial nitre beds, by the concurrent corruption of animal and vegetable substances, that nascent azote unites with oxygen, furnished by free air, which attaching itself to an alkaline or earthy base, as the case may be, produces an alkaline or earthy nitrate, and that calcareous substances facilitate considerably the union of azote and oxygen. This is the usual course of that putrefactive process, which generates nitre; but it must be remembered, that previously to the formation of nitric acid, other combinations of gaseous elements take place. The evolution of ammoniacal gas is a well known fact, the pre-existence of which, evidently proves, that azote was chemically combined with hydrogen, and that the hydrogen must have originated as well as the azote from the putrefactive substances. Whether oxygen unites directly with azote in a nascent state, or separates the azote from hydrogen, in ammonia, we will not enquire; but, as the smell of ammoniacal gas ceases when nitric acid is subsequently generated, we may infer, that either the ammonia was decomposed, or that the acid itself combines with it, forming nitrate of ammonia. Here then we have two instances of the combination of azote; the one forming ammonia and the other nitric acid. Whether the prot-and deut-oxide of azote are generated at any period of animal putrefaction is doubtful; but the latter, however, would combine with oxygen, and thus become acidified. Hydrogen, as it is a solvent of carbon, sulphur, phosphorus, &c. may be evolved in combination, as we find more particularly the case in the peculiar miasmata, evolved from marshes, and low wet land, which appear to be produced in such cases by vegetable decomposition. Marsh miasmata are generally the cause of intermittent fevers. Now under particular circumstances of action, may we not admit the generation of carburet of azote, or cyanogene? And if so, as it readily unites with hydrogen, may it not be the miasma, which produces malignant bilious fevers, since it is known that hydrocyanic

acid is destructive to animal life, and a most virulent poison? Cyanogene, and its compounds, may be generated in particular places, and, in fact, in the holds of ships.

It is admitted, I believe very generally, that hydrogen enters into the composition of gaseous effluvia, but with what substances, or in what state of combination is not known; I mean those effluvia, or miasmata, which produce disease. Hydrogen combines with sulphur, phosphorus, carbon, &c. but its combination with carburet of azote appears to be the most powerful, and at the same time the most destructive. And if we reason *a priori*, we may conclude, that chlorine as a disinfecting gas, which is the most powerful, acts by decomposing such compounds, thereby separating the hydrogen, and changing to the state of hydrochloric acid. Cyanogene, therefore, may be generated in putrefaction, and be combined with hydrogen. If that compound causes the deleterious miasmata, chlorine must act as we have stated; but if it be simple cyanogene, it may destroy its virulence by forming with it the chloro-cyanic acid. To prevent its influence, and its generation in sufficient quantity to poison the whole atmosphere of a district of a city, will be to employ freely chlorine gas, and the removal of ALL putrescent substances of every description, and to observe cleanliness in yards, streets, alleys, and bye places. On this subject, as it is one of peculiar importance with every one, who must feel interested in this investigation, I would advise an examination into *facts*, as they have occurred in Baltimore, Philadelphia, and New-York; and, in particular, I would refer the reader to a very interesting pamphlet on the subject of the *Yellow Fever* by Dr. Samuel Jackson of Philadelphia, which must be conclusive to every candid and impartial mind. The facts deduced by the Doctor were drawn from personal observation, and from official documents, as he was at that time President of the Board of Health. The fact is admitted, that miasmata of *some kind* are the cause of yellow fever. For our own part we believe it to be carburet of azote, or some of its combinations, and of these that with hydrogen, from its deleterious character, seems to be the one. This, however, admits of investigation; on which it must finally rest. We stated that when animal substances were calcined with potash, a cyanide of the alkali was produced. When this

cyanide is dissolved in water, it is changed into the hydrocyanite, for the hydrocyanic acid is certainly formed, whether by the decomposition of water, or otherwise.

When the solution of the cyanide of potash in water, whatever change it may have undergone during its solution, is added to a salt of iron in which the metal is peroxydized, as in the persulphat of iron, the precipitate which is formed is the perferrocyanite of iron. Admitting the formation of hydrocyanic acid in the first instance, we would infer, that, when brought in contact with the salt of iron, the acid itself is decomposed, or in other words is changed into the ferrocyanic acid, before its union with the oxyd of iron. Porret, however, considers the ferrocyanic acid as a compound of iron, oxydized to the minimum, and hydrocyanic acid. The conclusion of Dr. Thomson was, that it was merely a compound of metallic iron and cyanogene, but he subsequently inferred, that it is composed of iron and hydrocyanic acid. When the cyanide of potash is dissolved in water, and added to the sulphate of the plus oxydized iron, we obtain a *blue* precipitate, but if we employ the protosulphate, properly so called, the result is a *white* precipitate, which may be converted into the blue ferrocyanite either by exposure to the atmosphere, or by the affusion of an acid. If we admit that *metallic* iron enters into the composition of ferrocyanic acid, we would infer, that part of the hydrogen of the hydrocyanic acid, unites with a part of the oxygen of the oxydized iron, by which the iron is reduced, and the metallic iron then unites with the cyanogen and the remaining hydrocyanic acid, formerly the ferrocyanic acid; which, by uniting with the undecomposed oxyd of iron, produces the perferrocyanite or Prussian blue. It is known, however, that the Prussian blue used as a pigment, is a mixture of the perferrocyanite and allumina, in consequence of the addition of alum, which is made previously to the precipitation.

As prussic acid may be obtained by distilling peach blossoms, bitter almonds, &c. it is evident, that the vegetable kingdom will also yield it; and in many processes of art, the elements of cyanogene may frequently combine in such proportions as to form it. This indeed may be the fact in sundry other processes; as, for instance, in the pu-

trefaction of certain substances under particular circumstances and conditions.

The fact, however, I purpose to notice is, that sometime since I was exhibiting to my class some experiments on the decomposition of nitric acid, and of nitrate of potash by charcoal, in relation to the subject of gunpowder. When I affused nitric acid on charcoal, there was, as is usual, a disengagement of the deutoxyde of azote, and on standing, the acid became thick and brown, and to all appearance resembled artificial tannin, which we know is obtained by a similar process. It struck me as a circumstance not improbable, that besides the formation of nitrous gas and carbonic acid gas, cyanogene might be formed. It appeared to me, that whilst a portion of carbon combined with a part of the oxygen of the nitric acid, and the deutoxyde of azote was disengaged, a part of the carbon might unite with a portion of azote, and thus generate cyanogene. Whether this explanation will hold good, I will not pretend to say, but it is certain, that cyanogene was generated. By putting the charcoal and nitric acid into a retort, and collecting the gaseous products in Woulfe's bottles, arranged in the usual manner, the gases evolved were all, or the greater part, absorbed; that is to say, the nitrous gas was converted into nitric acid, by its union with the oxygen of the air contained in the bottles, &c. I saturated the water, thus impregnated, with potash, by which I formed a nitrate, carbonate, and cyanide of that alkali, as the latter was subsequently manifest. To this fluid, I added the common sulphate, and the persulphate of iron. The colour instantly changed, and became more or less *blue*, proving the existence of the perferrocyanite of iron, and consequently of cyanogene, which must have been formed by the union of carbon and azote. We may conclude then, that during the action of the nitric acid on the carbon, which caused the developement of nitrous gas, a part of the azote of the acid must have combined with the carbon, and that another portion of the carbon, by uniting with the oxygen of the decomposed nitric acid, produced carbonic acid. The carbon in this case must have taken up a part of the azote, as well as a part of the oxygen.

If the carbon abstracted the *whole* of the azote from a given portion of nitric acid, the inference would be.

that pure oxygen was liberated; and if it took the oxygen, or a part of it, from the deutoxyde, already generated by the union of carbon and oxygen in the formation of carbonic acid, thereby leaving a compound of azote and oxygen in the state of nitrous gas—it must have reduced it to the protoxyde, or gaseous oxyde of azote, its first degree of oxydizement.

It is known that charcoal, especially when newly made, has the property of absorbing sundry gases, and particularly hydrogen. Might not the charcoal I used have contained hydrogen? If so, might not the nascent hydrogen during the action of the carbon, have combined with a part of the oxygen of the nitric acid, and formed water; whilst that portion of the azote thus set at liberty, by combining with the carbon, may have formed the carburet of azote?

The existence of cyanogene, however, is indisputable, in whatever manner it may have originated. One atom of azote and two atoms of oxygen form the deutoxyde of azote, and two atoms of carbon with one atom of azote form cyanogene. I have not had leisure to repeat the experiment, in order to determine the quantity of cyanogene thus generated.

ART. IX—*Analysis of a Manganesian Garnet, from Had-dam, Connecticut, with a notice of Boric Acid in Tourmalines; by HENRY SEYBERT.*

THIS mineral occurs imbedded in granite, associated with Cymophane and Beryl. In mass it is blood red; the powder is flesh coloured. Lustre, resinous. Small fragments are transparent. The specimen made use of for analysis was a portion of a large crystal. Fragments, indeterminate. Scratches glass and scintillates with steel. Very frangible. Structure lamellar. Specific gravity 4.128. Fusible, before the blowpipe, into an opaque black bead.

Analysis.

A. 3 grammes of this garnet, in the state of an impalpable powder, were exposed to a red heat in a platina crucible; after the calcination, the colour of the powder was not sensibly altered, and it weighed 2.98 grammes, there-

fore, the moisture expelled by this treatment, was 0.02 grammes on 3 grammes, or 0.66 per 100.

B. The residue of the preceding calcination, (A) was calcined, at a red heat in a platina crucible, during 30 minutes with 15 grammes of sub carbonate of Soda, the mixture did not enter into fusion, but merely assumed a pasty consistence; when cold the mass was of a very deep green colour, the water which was used to detach it from the crucible was also intensely green—an indication of a large quantity of Manganese. When an excess of muriatic acid was added to the liquor, *chlorine* was abundantly disengaged, the solution was not perfect until the evaporation of the liquor was considerably advanced, it was then of a deep orange colour; to effect the separation of the silica it was evaporated in the usual manner to a dry gelatinous mass, then treated with water, acidulated with muriatic acid, and again moderately evaporated; more water was added, and the solution was filtered; the silica remaining on the filter, after edulcoration and calcination, weighed 1.075 grammes on 3 grs. or 35.83 per 100.

C. The silica having been separated, (B) the excess of acid was neutralized with caustic potash, the solution was treated with hydro-sulphate of potash, this occasioned a precipitate, which at first was black, but the latter portion of it was nearly colourless. The precipitate was well washed and dissolved, in the humid state, in nitro-muriatic acid, the solution was evaporated to dryness to expel the excess of acid, the residue was treated with water, and boiled during one hour and a half with an excess of caustic potash, the filtered liquor was treated with an excess of muriatic acid, then by ammonia there was formed a precipitate of alumina, which, after being washed and exposed to a red heat, weighed 0.542 grammes on 3 grammes, or 18.06 per 100.

D. The residue, which was separated from the alkaline liquor, (C) was of a dark red colour; it was treated while humid, with acetic acid, the solution was evaporated, at a moderate temperature, to perfect dryness, the dry mass was treated with water, the peroxide of iron, collected on a filter, proved to be free from alumina and manganese, it weighed 0.486 grammes; a portion of the pulverized mineral was treated with nitric acid and calcined; the powder, which was flesh coloured, now became nearly black, this

change of colour clearly proved, that the iron and manganese existed in a minimum state of oxidation, therefore, the 0.486 grammes of peroxide of iron must be reduced to the state of protoxide, and are equivalent to 0.448 grammes of protoxide of Iron on 3 grammes, or 14.93 per 100.

E. The filtered liquor, (D) was boiled with an excess of sub-carbonate of soda, the carbonate of manganese thus precipitated, was washed and strongly calcined, the tritoxide of manganese weighed 1.007 grammes, and on examination was found to contain neither alumina nor iron: the 1.007 gr. of tritoxide are equivalent to 0.929 grammes of protoxide of manganese on 3 grammes, or 30.96 per 100.

F. The liquor (C), after filtration was successively tested with oxalate of potash, and with caustic potash, and thus proved to contain neither lime nor magnesia.

According to the preceding experiments, the constituents of this Garnet are

	per 100 parts,	
A. Water, - - -	00.66	containing oxygen
B. Silica, - - -	35.83	- - - 18.02
C. Alumina, - - -	18.06	- - - 08.43
D. Protoxide of Iron, -	14.93	- - - 03.39
E. Do. of Manganese	30.96	- - - 06.79
	100.44	18.61

And its mineralogical formula will be $fS + 2mgS + 2AS$.

Boric acid in Tourmalines.

To detect the Boric acid in the green Tourmaline, from Chesterfield, Massachusetts, a portion of the mineral was pulverized, and calcined at a red heat, with three parts of caustic potash; the mixture after calcination, was treated with muriatic acid and evaporated to a dry gelatinous mass, which was afterwards digested in alcohol; the alcoholic solution, when ignited, burnt with a beautiful green flame, a proof of the presence of Boric acid; the same acid was also found, by a similar treatment, in the *Rubellite* and *Indicolite* from Massachusetts, and in the *black* Tourmalines from Haddam, Connecticut, and Chester creek, Delaware Co. Pa.

ART. X.—*Letter from Dr. WILLIAM MEADE, communicating an account of a travelled stone, &c.*

TO PROFESSOR SILLIMAN.

Sir,

IN your Journal for June, 1822, an anonymous communication appeared, giving an account of certain rocks supposed to have moved without any apparent cause, in the town of Salisbury in Connecticut. Finding that this account though very circumstantially related, has been generally received with great incredulity, I beg leave to send you the following very well authenticated statement, on a similar subject, which I have copied from the Memoirs of the Wernerian Society of Edinburgh for the year 1819, a publication of great merit and respectability.

You will perceive, Sir, that the circumstances attending the movement of this *Travelled Stone*, as the journalist emphatically calls it, are so very similar to those detailed by your anonymous correspondent, that there can remain no doubt of the main facts, or that they were produced by the same causes.

I am farther induced to send you this paper, from the transactions of the Wernerian Society, not alone from its establishing the fact of the occasional change of position of certain large masses of stone, but from its tendency to explain some Geological facts, which as yet appear to be little understood.

I have the honor to be, Sir,

your very obedient servant,

WM. MEADE.

Account of the Travelled Stone near Castle Stuart Invernesshire; by THOMAS LANDER DICK, Esq.

[Read 17th May 1819.]

This stone is a large mass of conglomerate, being a concretion composed of distinct irregular fragments of granite, gneiss, quartz, and other rocks of the primitive series, cemented together by a highly indurated and ferruginous clay

slate. I am not aware that any rock of the same nature exists much nearer to it than seven miles. Its present situation is on the sands in the little bay near Castle Stuart on the Mercey Firth. Its size is very considerable, being as near as I could guess above four feet high at its most elevated point, calculating from the surface of the sand and being to all appearance about one foot imbedded in it. It measures between four and six feet one way by six or seven the other; its shape, which is very particular, is peculiarly well adapted to admit of the mode of transportation, it underwent, as it had a projecting edge, all round it, the lower edge of which, is above a foot of perpendicular height from the surface of the sand, and from this edge downwards, the stone is suddenly bevilled off in a form resembling that part of the bottom of a boat which is under the belly and approaching the keel. On as near a calculation as I can make, it may weigh about eight tons.

This large mass is remarkable for having been removed from a situation which it formerly occupied, about 260 yards farther to the S. S. E. by natural means, and in the course of one night to the position where it now stands. It had formerly served as a boundary stone between the properties of Castle Stuart and Culloden, the former belonging to the Earl of Moray and the latter to Duncan Forbes, Esq. As it is too ponderous to have been moved by human power, at least in that part of the country, it must have been originally deposited in that its first place of rest, by causes similar to those which have covered whole countries with boulders, the nature of which bespeaks their having belonged to rocks no where existing in situ in their entire and native state, in the vicinity of their present place of abode. The stranger scarcely recognizes the spot from which it was last removed, it being marked by a wooden post which the two contiguous proprietors were under the necessity of erecting in order to supply the place of the stone, and to serve as an object for defining its line of *march*. At a fishing village situated above a mile to the westward of the stone, I learned several particulars with respect to its extraordinary migration. But it was recommended to me to call on the miller of *Pitty* for a fuller detail of the facts, who, living much nearer the stone, and having it constantly in view for a series of years, not only recollected every circumstance about it, but was

the first person who on the ensuing morning noticed that it had been removed during the night.

I lost no time in seeing the old man whose name is Alexander Macgillivray, and I was lucky enough to find him at home, he informed me that this remarkable circumstance took place on the night between Friday the 19th, and Saturday the 20th of February, in the year 1799. There had been a very severe frost, and the greater part of the little bay had been for some time covered with ice, which was probably formed there the more readily owing to the fresh water from the stream running near to Castle Stuart, emptying itself into the inlet of the sea in the immediate neighbourhood. The stone was, by this means, fast secured by the ledge, which I have described being bound round by a vast cake of ice of many yards in extent, which being froze hard under the projection of the stone, must have produced an admirable mechanical means for its elevation, for which purpose it afforded an extensive draft. The miller told us he had measured some of the ice and found it eighteen inches thick. The stone was then surrounded when the sea left it at its ebb, and the whole of the circumjacent land was left covered by this solid and unbroken glacier. It is evident that as the sea began again to flow, this would be naturally buoyed up by the returning water insinuating itself underneath it on the night of the 19th of February, the tide which happened to be remarkably high, was full about 12 o'clock. About this time, the wind began to blow a hurricane, accompanied with drifting snow. The old man stated that this tremendous storm blew directly from Dulcross Castle, and accordingly I found that by placing myself at the stone and looking at Dulcross, the post marking the former situation of the mass appeared quite in the line between those two points, and that the strait line or furrow described by the stone in the course of its voyage lay in this direction.

When the old miller got up on the morning of Saturday, the 26th, the storm and drifted snow was such that he could hardly make his way to his barns, though they are but a few yards distant from his dwelling house. When the weather had moderated in some degree, and the storm and snow had cleared away, so that he could see across the little bay, he remarked to his wife with much astonishment

and no inconsiderable alarm, "*That the mickle stane was awa,*" and the good woman could hardly believe her eyes, when she saw in reality that it was gone from the spot it had occupied the day preceding and that it had been removed to the position where it now remains. General surprise and curiosity were now excited which were no doubt mingled with superstitious fancies, and the neighbours flocked out to see and examine the subject of so extraordinary a prodigy. To their astonishment the hole in which it had been for so many ages imbedded, still remained to mark distinctly its yesterdays site, whilst its track across the flat oozy sand was very perceptible, extending in a line from its old to its new situation. In addition to these particulars I have since learned from my friend Mr. Bradie that he visited the stone the day after, when he found all the traces remaining quite apparent and an extensive cake of ice adhering to the stone being attracted to its outer ledge.

It is evident that this vast mass of stone must have been so far rendered specifically lighter than the water by the great cakes of ice within which it was bound, and by which it was supported, as to be in some degree buoyed up, and that whilst in this state, it was carried forward by the outgoing tide, assisted by the impelling force of a tremendous hurricane blowing in the same direction.

By the correspondence just detailed, we are furnished with a comparatively recent and perfectly well attested example of one mode by which large masses of detached rock may be carried to considerable distances. For although the waters of the tide which fill the bay in question, were on account of their shallowness, incapable of buoying up the extensive float of ice supporting the stone so perfectly as to prevent the keel of it from ploughing the sand in the course of its progress over it, yet there is no reason to doubt if it had been once fairly carried into deeper waters it might have been ultimately transported to a much greater distance. And if we can suppose the float of ice to have been sufficiently tough and tenacious, we may even conceive it probable that the stone might have been deposited upon some remote shore, where no rock of the same nature was to be found, and where it might have fur-

nished future Geologists subjects for more interesting speculation. These would have been naturally the more puzzling that its peculiar mode of transportation would have precluded all chance of its acute angular projections being destroyed by attrition and so would have prevented the possibility of its exhibiting those appearances of its having been rounded and polished, so manifestly displayed, by most of those stones usually denominated boulders. How far the causes which are thus known to have operated in producing the removal of this vast fragment may appear to tally with the relative situation of similar masses in other places which cannot be so easily traced to their parent rock, or to ascertain whether such means may not have had some share in transporting these to their new situation, may perhaps merit investigation, and with such a view an accurate and well attested narrative of the particulars of the conveyance of the *Travelled Stone* near Castle Stuart, from its former to its present place of quiescence, cannot be considered as altogether useless in the pursuit of Geology.—*Vide Memoirs of the Wernerian Society of Edinburgh, Vol. III. p. 250.*

ART. XI.—*Remarkable Balls of Snow, observed at Brunswick, Me. April 1st 1815.*—By Prof. CLEAVELAND.

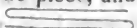
During most of the day, preceding this phenomenon, a fine mist continued to fall; and, in the former part of the night, the wind changed to N. W. accompanied by the fall of nearly two inches of very light snow. On the following morning, in the fields and roads, were to be seen a great number of *snow balls*, varying from *one* inch to *fifteen* inches in diameter. When small, their form was nearly spherical; but the larger balls were generally somewhat oval, having been rolled a considerable distance in one direction by the wind. Their texture was homogeneous; they were extremely light, and composed of minute prisms of snow irregularly aggregated. When very small, they would hardly bear examination in the hand without falling to pieces; when larger, they had become more compact. The paths, in which they had rolled, were in general distinctly visible. The smaller balls,

however, were observed in the *woods*, and in *small yards* and other inclosures, sheltered from the wind, thus indicating that their formation commenced in the atmosphere. Similar balls were observed in most of the contiguous towns. Their appearance on the river Androscoggin was extremely interesting.

ART. XII.—*Miscellaneous Notices by Prof. J. F. DANA, of Dartmouth College.*

1. *Connexion of Electricity, Heat, and Magnetism.*

The notices which have appeared in your Journal on the connexion between Electricity and Magnetism have induced me to make some experiments, and as they tend to confirm those made by Mr. Bowen, I will mention them. The apparatus consisted of the Leyden bottle and glass tubes surrounded by brass wire. I have not yet had opportunity to repeat any of the experiments with the galvanic battery, except in one instance when a piece of steel was inclosed in a glass tube half an inch in diameter and surrounded by a spiral coil of brass wire, and the influence from my battery, consisting of two hundred plates six inches square, was passed through the coil for one minute, the steel did not appear at first to be affected, *but the next day was found feebly magnetic*—this experiment was made at the same time on another and similar piece of steel with the same result. With common electricity I have been more fortunate. When the charge from a small Leyden jar was passed through the coil the steel inclosed in the tube was uniformly rendered magnetic, if the coil passed from right to left the south pole was always found on the negative end, whether the jar was charged with positive or negative electricity; when the coil passed from left to right, the north pole was uniformly formed next the negative, whether the jar was charged with positive or negative electricity. These two experiments confirm those of Mr. Bowen. In using a tube surrounded by a coil passing from right to left for one half its length, and then in the contrary direction, as in Mr. B's. experiment, I found, when the jar was charged with positive electricity, and the coil began to pass from right to left on the positive, that both

ends of the enclosed steel became north, and the middle south; if on the contrary, the coil began to pass from left to right, on the positive side, both ends of the steel acquired a south polarity and the middle a north polarity. When the jar was charged negatively, and the coil began to pass from right to left on the negative, both ends acquired a south and the middle a north polarity; if the coil begin to pass from left to right on the negative side the polarities are reversed. When a wire is bent into the form of a staple (thus ) and inclosed in a glass tube surrounded by a spiral passing from right to left, the ends acquire a north polarity, and the middle a south polarity, if the ends of the staple be next to the positive. If the situation of the staple be reversed, or if the coil pass from left to right, then the ends become south and the middle north. Circumstances did not permit me to make the experiment on a staple surrounded by the coil passing from right to left, and from left to right. We should, a priori expect, that the middle of the staple in such circumstances, would acquire the same polarity as the ends, while at some intermediate points on both sides of the middle an opposite polarity would be found, so that five poles would be formed in one piece, and if the wire was again doubled on itself, (thus ) two additional poles would be formed. The above experiments were many times tried with the same result, and have been repeated by myself and my friend Hon. Thos. Whipple, M. C.

2. *Preparation of Euchlorine Gas.*

I perfectly well recollect, when I had the pleasure to be introduced to you at Cambridge, that the conversation turned on the preparation of euchlorine gas; we naturally wish to know whether experienced chemists meet with the same accidents as ourselves, in experiments, and it was no small degree of consolation to learn that the laboratory at Yale had also witnessed accidents in the preparation of this explosive gas. For two years past I have prepared it in the following manner; strong phials capable of holding half an ounce or an ounce measure are provided, into which are put a few grains of chlorate of potash, and then, four or five drops of sulphuric acid, just sufficient to moisten the salt, are added; the phials are then inverted over mercury, ma-

ny air bubbles escape ; but in a few minutes the phials appear filled with the euchlorine, which is readily known by its colour and odour. The gas thus prepared is of course impure, but is doubtless as pure as most gases used for chemical demonstrations ; it explodes violently by heat and on the contact of phosphorus ; it is absorbed by water, to which it communicates its peculiar colour. Since I have employed this method, only one accident has happened to me from this gas, it then exploded spontaneously and threw the phial with great force against my forehead, and the mercury in the vessel over which it was inverted was dashed around in all directions.

Memorandum.—The remarks of Professor Dana, induce me to add, that, for several years, I have obtained euchlorine gas, without accident, by the following process. Chlorate of potash and muriatic acid diluted with an equal volume of water, are placed in a small glass flask, furnished with a glass tube, bent twice at right angles, and passing to the bottom of any clean dry phial, flask or tube, rather deep and with a narrow neck ; a spirit lamp, a water bath, or any mild heat, applied beneath the flask, soon disengages the euchlorine gas, which, by its great weight, displaces the common air, from the recipient, and occupies its place. By using tongs, of a peculiar form, furnished with corresponding curvatures on their opposite sides, so as to embrace tubes, or the necks of vessels securely, the glasses filled with the euchlorine gas may be so managed that the operator can perform all the experiments, without touching them with the hands, by which means the danger of premature explosion is avoided.—*Editor. Dec. 19, 1822.*

3. Concretion from the Tonsil.

Mr. Bancroft, a medical student, was afflicted with a severe inflammation of the tonsils ; it separated and a small concretion was discharged from it. The concretion was of an irregular form, and weighed less than half a grain. Its colour, light brown ; surface smooth, and through a lens appears composed of smooth rounded grains, exhibiting a *botryoidal* appearance. Before the blow pipe it blackens and then becomes white, and is infusible. Soluble in muriatic

acid; the solution affords a precipitate by oxalate of ammonia, and by pure ammonia—hence it consists of phosphate of lime and animal matter.

ART. XIII.—*Notice of an ancient Mound, near Wheeling, Virginia*; by S. MORTON.

To the Editor.

WHEELING, Aug. 7th, 1822.

My Dear Sir,

Since I attended your lectures, I have resided at Wheeling, Virginia, within twelve miles of the Great Mound, at Grave Creek, on the Ohio river. A few weeks since, I had the curiosity to measure this remarkable monument of antiquity, and as the following results, with a general description of the mound, may not be uninteresting to you, I therefore humbly submit them. J. MORTON.

The plain on which this mound is situated, extends back from the Ohio river about a mile and a half, is of a semi-circular form, open towards the river, but enclosed on its back part by high hills. It is nearly level, forming a beautiful site for a town. The soil is a yellowish loam, mixed with a small portion of clay; it is at present, rather unproductive, having been nearly exhausted of the vegetable mould by several years cultivation. The principal mound stands about an eighth of a mile from the river, nearly in the centre of the plain, from north to south. The form of this remarkable tumulus is nearly a circle, at its base, converging gradually like a cone, but terminating abruptly.

The circumference at its base, is about two hundred and fifty yards. The summit is sunk like a basin, making a diameter from verge to verge, of about twenty yards. Judging from this circumstance, it has evidently been much higher than at present, but this is also evinced by the immense quantity of soil about its base, which has been washed from its sides by the rains of ages. Its perpendicular height, is now nearly seventy feet; the slope from base to summit, or verge of the basin, measures about one hundred and twenty-four. From this sunken appearance of

the top, and the form of other mounds in the neighborhood, it is reasonable to conclude that its perpendicular was once twenty or thirty feet higher.

It is composed of a soil similar to that of the plain which surrounds it, but there are no local marks to determine from whence such a quantity of earth could have been taken, as the surface of the plain is nearly level. The mound itself is covered with trees, consisting of white and black oak, beech, black walnut, white poplar, locust, &c. and many of them are of a large size.

A white oak, in particular, on the verge of the summit, measures twelve feet in circumference, three feet above the surface of the ground. From its size, and the decayed appearance of some of its branches, it must have been the growth of four or five centuries. There are several others of nearly equal size. The vegetable mould in the centre of the basin, is about two feet in depth, but gradually diminishes on each side. About one eighth of a mile distant on the same plain, in a northeasterly direction, are three smaller tumuli of similar construction; and several other small ones in the neighborhood. Near the three alluded to, on the most level part of this plain, are evident traces of ancient fortifications. The remains of two circular entrenchments, of unequal size, but each several rods in diameter, and communicating with each other by a narrow pass, or gateway, are to be seen, and also a causeway leading from the largest towards the hills on the east, with many other appearances of a similar nature, all exhibiting marks of a race of men more civilized than any of the tribes found in this section of the country when first visited by Europeans.

Several attempts have been made to open the principal mound, but they were arrested by the proprietor of the ground.

In stamping or striking with a club on the top of this huge heap of earth, a hollow, jarring sound may be heard and felt, similar to that which we feel in walking heavily on a large covered vault.

With regard to the object of these structures, it is now, I believe pretty well agreed, that they were repositories for the dead. A good evidence of this is, that a substance resembling decayed bones has generally been found in those which have been opened, with implements of war

and various articles used by savage nations. Otherwise we have no certain data; no historical facts to guide us in our enquiries into this subject. Not even tradition, for the tribes inhabiting the country when discovered by the whites, were more ignorant, if possible, of the origin and uses of these mounds, than we are. They had not even the shadow of tradition to give them the smallest light on the subject. All we know of them is derived from a very few obvious facts, the rest is speculation drawn from slight probability. Very respectfully, yours,

J. MORTON.

• Wheeling, Virginia.

INTELLIGENCE AND MISCELLANIES.

I. DOMESTIC.

1. PROTEST of Mr. Henry Seybert, in vindication of his claim to the discovery of Fluoric acid in the Chondrodite (Brucite of Col. Gibbs, Maclureite of Mr. Seybert) in reference to a passage in the Memoir "on the minerals, &c. of Patterson, and the Valley of Sparta," &c. by Mr. Thos. Nuttall, with the reply of the latter.

Remarks by the Editor.

As Mr. Nuttall happened to be present with me, when Mr. Seybert's communication was handed in, I thought it but *candid* to show it to him and to receive his reply. I will not deny that I was actuated also by the hope of bringing this difference to a prompt issue, *without having it continued into a subsequent number.*

Letter of Mr. Seybert.

TRENTON, Nov. 11, 1822.

SIR,

Absence from Philadelphia, until within a few days, prevented my having an opportunity, to peruse the second number of Vol, V. of your Journal of Science and Arts.

Some of Mr. Nuttall's "Observations and Geological Remarks on the minerals of Patterson and the Valley of Sparta, in New-Jersey," excited my surprize; and I regret, extremely, that the necessity of the case forces me into a controversy; justice, however, demands that I should notice some of the remarks of that gentleman.

When speaking of the Condrodite* Mr. Nuttall says, that it is according to an *unpublished* Analysis, which he made in 1820, "a Silicate of Magnesia, with an *accidental* portion of Fluoric acid and iron,"† thus leading us to believe, that he was the first, who detected Fluoric acid in that mineral: the following facts will satisfy the reader, in how far he has any claim to that discovery. On the 3d of April 1821, a communication, concerning the Condrodite, from Mr. Nuttall was read before the Academy of Natural Sciences, in Philadelphia; in that essay he made known the results, which he obtained from an analysis of that substance, *without enumerating Fluoric acid as one of its constituents*; on the contrary, he satisfied himself that that acid *did not* exist in the mineral in question. These are facts which Mr. Nuttall dares not venture to contradict, and they are known to the members of the very respectable institution, to which they were communicated. Why does Mr. Nuttall now pretend, that he detected Fluoric acid in the Condrodite in 1820, when in a paper read before the Academy of Natural Sciences in 1821, he denies its existence, without any allusion to a previous discovery? Mr. Nuttall's Communication was referred to a committee; on account of its chemical imperfections, it was deemed unworthy of a place in the transactions of the Academy!

In March, 1822, I detected the Fluoric acid in the mineral found at Sparta, New-Jersey; this fact was a subject of conversation amongst our Chemists, immediately after it was substantiated; it was announced to you, in a letter dated 18th of April, 1822, and you noticed it in the first number, volume 5, p. 203, of your Journal. On the 17th of May last, my paper, on this subject, was read before the

* The same mineral which I called "*Maclureite*," for reasons assigned in the Journal of Science and Arts, Vol. V. p. 343.

† Journal of Science and Arts, Vol. V. p. 245.

American Philosophical Society, the results of my experiments were noted in their minutes, and to these Mr. Nuttall being a member of that Society, had free access. From the sources abovementioned, he could, in 1822, correct the results, which he had laid before the Academy of Natural Sciences in 1821, and thus pretend, that he anticipated me as early as 1820. He pretends that the Fluoric acid, in the Condrodite, is *accidental*, without informing us of the quantity, or of the method which he followed to detect it. Why did he neglect to publish his analysis in detail? The subject was worthy of such notice, more especially as the Fluoric acid, in this mineral, had escaped the sagacity of the celebrated Berzelius. To every Chemist, the error of Mr. Nuttall's statement must be evident, because the 4.086 per 100 of Fluoric acid, which I obtained from this mineral, must be an *essential*, and not an accidental constituent, otherwise we cannot account for the saturation of the bases, which enter into its composition. It was the want of the knowledge of the presence of this acid, that forced Professor Berzelius, to resort to a peculiar formula, (*formule particulière*) founded on the principles of definite proportions, to represent the condrodite, in his system of Mineralogy, as Silicaté of Magnesia.*

Mr. Nuttall was mistaken when he told us that "Haüy referred the Condrodite to the peridot.† On the contrary, the celebrated crystallographer remarks, that although, from an analysis of this mineral, made by Berzelius, the results were similar to those afforded by the peridot, *they cannot be referred to the same species*. The following are the words that Haüy employs, when he refers to the analysis of Berzelius. "On en avait même fait l'analyse, dont le resultat se rapprochait beaucoup de celui *que donne le peridot*. Mais ayant entrepris d'examiner la structure de ces cristaux, je trouvai que leur division mécanique conduisait à un prisme rectangulaire à base oblique, *ce qui les rendait incompatibles dans une même espece, avec le peridot qui a pour forme primitive un prisme droit*."‡

* Annales des Mines, Tome 6, p. 528.

† Journal of Science and Arts, Vol. 5, p. 245.

‡ Annales des Mines, Tome 6, p. 528.

If I was disposed to favor controversy, there are other subjects connected with my name, in Mr. Nuttall's paper, that would induce me to make further remarks, but it is with great reluctance, that I offer the above for publication, in the next No. of your Journal, and

With sentiments of regard and esteem,

I remain your obedient servant,

HENRY SEYBERT.

PROF. SILLIMAN, Yale College, New-Haven.

Letter of Mr. Nuttall.

Philadelphia, Dec. 15, 1822.

Dear Sir,

I have hitherto avoided controversy, and occasionally borne the lash of unjust criticism, in silence, rather than run the risque of trespassing on the patience and temper of the public by the temerity of an appeal. I now, therefore, regret that imperious circumstances, and such as are connected with the support of moral dignity should have urged me to this unwelcome task.

I believe no man can more highly or justly appreciate the scientific character of your correspondent than I do, otherwise I should have suffered his assertions to have passed unheeded.

If I am called upon, as you are aware, by Mr. H. Seybert, to say when and where I had heard of the existence of Fluoric acid in the Brucite or Chondrodite I might refer him back to a period when he was too young to have been acquainted with even the name of Chemistry. I might bring to his recollection, the name of an amiable and scientific man (the late Dr. Bruce) in honor of whom it was called by Colonel Gibbs, and in whose laboratory this result was obtained by Doctor Langstaff,* of New-York, then his pupil. It

* On the subject of this experiment, I received the following note from Doctor L. dated Nov. 27th, 1822. "Agreeably to your request of the 25th inst. I have referred to my notes made on the Sparta mineral, (Brucite) and find that my experiments on the composition of that substance were made in the fall of 1811. A want of time prevented me from making an accurate analysis, but from the experiments then made, I find it yielded about,

Silex,	-	-	-	-	-	32
Oxid of Iron,	-	-	-	-	-	6

was announced by Professor Cleaveland in his first edition of *Elements of Mineralogy* under the name of *Brucite* as a *Fluate* of magnesia without noticing the presence of *silex* so distinctly obtained by Doctor Langstaff. Nor can I omit the experiments made five years ago by my friend Doctor Torrey, who also found the existence of *Fluoric acid* as well as the other ingredients mentioned in the analysis of Doctor Langstaff, in the *Brucite*; but omitted their publication in deference to the prior labors of Doctor L. from whom he expected an analysis.

My assertion that this acid (the *fluoric*) may be *accidental* rather than *essential* in the composition of the *Brucite*, is grounded, I hope with some reason, on its absence in the analysis made by a chemist so celebrated and so accurate as Berzelius. The contiguity of slender veins of *fluat* of lime to the masses of *Chondrodite* or *Brucite* near to Franklin furnace at Sparta was also an additional inducement to consider this acid as *accidental*. Its variable proportion appears also in corroboration of this opinion.* After all, I am in no way anxious on the subject, and am perfectly willing that Mr. Seybert should consider the *fluoric acid* as *essential*, while I, for want of better proof, shall still be inclined to consider it as *accidental*. I would hope, that as lovers of science and of truth, these and many other discrepancies of opinion on matters of this kind, might harmlessly and even honorably be entertained, without any necessary reference to the opinion of the public, who may be inclined rather to ridicule us for contention, than credit us for any claim to merit.

Magnesia,	-	-	-	-	-	51	
Water,	-	-	-	-	-	2	and by abstraction
Fluoric acid,	-	-	-	-	-	9	
						100	

Yours truly,

W. LANGSTAFF."

Doctor L. assured me from his minutes made at the time that the *Fluoric acid* then obtained from the *Brucite* was sufficient to engrave and corrode a plate of glass.

* Since publishing the account of this mineral, several other localities of it, particularly at West Point in the state of New-York, have been discovered. I have likewise observed it in several more specimens, with *Idocrase* and *mica* from *Vesuvius*; in these no trace of *fluoric acid* has as yet been discovered, it is consequently, very nearly related to *olivine*, in its chemical composition.

Not having an opportunity to refer to the original communication of the celebrated Haüy at the time when I hastily drew up the account you favored me with publishing of the minerals of Sparta, I may possibly have been inadvertently led into some trifling error in the statement of the circumstance alluded to by Mr. Seybert. Indeed

“To err is human,—to forgive, divine.”

For assuredly, I never entertained the presumptuous idea, of attempting to grasp at a single leaf of the immortal laurels of the great, and venerable and lamented Haüy!

But, I hope in future, Mr. Seybert will view me with less jealousy, for I should be sorry to be considered any thing less than his friend, or that of any young man of such eminent pretensions to useful science. I have no pretensions to analytical chemistry, having merely amused myself occasionally with a few imperfect essays, to satisfy an ardent curiosity concerning the character of a few ambiguous minerals. I undertook the task, because, at that time, no one else would engage in it. But I now rejoice to see a spirit of emulation spreading through this interesting country, so honorable and useful to its native genius and physical resources.

I am, Sir, with high respect,

Your humble servant.

THO'S. NUTALL.

2. Iron Conduit Pipes.

The increasing efforts which are making in this country to supply our cities with good water, give a peculiar interest to every thing connected with this subject. One of the principal practical difficulties in these undertakings arises from the bursting, leaking and decay of the waterpipes. Many years ago they were formed of cast iron in Scotland, and it appears that cast iron pipes are now in full and successful use in the new river water works near London. We have before us the report of the watering committee of Philadelphia, which contains an important correspondence between the committee and Mr. Walker the engineer of the London new river water works. We are assured by Mr. George Vaux of Philadelphia, to whom we are indebted for these facts, that the information communicated by Mr. Walker, “has been found by experience, during the last four years to be

most correct and important." It is not possible to do justice to the statements of Mr. Walker without copying his letters entire. The most important results however are that cast iron pipes of any necessary diameter, even to two or three feet, may be employed—that their strength is sufficient to resist any desired pressure, when the thickness of their sides is very trifling, three quarters of an inch being sufficient for pipes of twenty inches diameter—three eighths of an inch for ten inches, and three sixteenths for a five inch pipe; that the pressure, with a head of one hundred and forty feet, is about sixty-two pounds on the square inch, "which is much less than one tenth of pressure which a good casting of one foot diameter and a half inch thick, is capable of resisting: the tenacity of a square inch of the best cast iron, having been found by experiment to exceed twenty thousand pounds"*—that the joints of the pipes can be rendered impervious and secure—that the iron is very enduring—imparts no disagreeable taste to the water—is, when properly prepared, always to be depended on, and in the course of years is more economical than any other substance.

The joint used in London, for connecting the pipes is the spigot and fauset, made tight in some cases, by lead cast around, and in others by a cement which is composed of two pounds of sal ammoniac with one hundred pounds of borings of iron, with the addition of a little sulphur. These materials are mixed with water which "oxidizes the iron, and in a short time the mixture becomes extremely hard and quite impervious to water."

When lead is used it is contracted by cooling, and it is necessary to *upset* the joint with a hammer and chisel.

The following extract of a letter to the Editor, dated, December 25, 1822, from Mr. Vaux, contains much valuable information.

"Our experience I consider to be decisive, especially in relation to the all important matter of the joints of the conduits.

* The proof of these pipes and cocks is made by the hydraulic press and those sent out by Mr. Walker to Philadelphia, were proved by a pressure equal to a column of water of three hundred feet in height, that is of the weight of nine or ten atmospheres.

"The pipes of whatever size, are usually cast in sections of nine feet, and are always laid so as to have a covering of earth at least four feet thick. During the last three or four years about thirty thousand feet have been put down by the city of Philadelphia, and between three and four thousand joints have been made. The pipes vary in diameter from twenty-two to two inches, and in no single instance has there appeared any difficulty from the change of temperature, or in fact from any other cause—although our head of water in the highest part of the city, is sixty feet and in the lower parts near ninety—the pressure of which is never removed.

In making the joints the directions of Mr. Walker are pursued, but our workmen instead of stopping the opening between the pipes with clay only, previous to pouring in the liquid lead—clasp the *inserted* pipe with an iron ring composed of two semicircles of common hoop iron bent edgewise and united on one side, by a joint or hinge, and on the other by a thumb-screw—thus . This ring being placed directly against the end of the *receiving* pipe, covers the space between the two pipes, and the clay is then applied over it. When the lead is poured in, the surface next to the ring will be smooth all round, and the troublesome operation of "chipping" and "dressing" is entirely saved.

The persons engaged in making the joints have acquired such confidence in their work, that they no longer deem a proof necessary, but fill up and puddle the ditch before the water is turned into the pipes.

The information now possessed I consider of great importance, not only to our city but to the country at large, as without it iron could not be used for conduits—there being I believe no other effectual mode of securing the joints; in fact a knowledge of this matter twenty years ago would have saved us at least \$100,000. When the water works were first erected by Mr. Latrobe, he put down about a mile of iron pipe, but from the contraction it was found not to succeed. Various attempts were made to obtain information from England, all of which failed previous to the application to Mr. Walker.

Our new water works are not upon the plan recommended by Mr. Walker, though some of his recommendations

have been adopted. There is no description of them in print, and I cannot personally furnish you with answers to your enquiries at this time. In the course of a few weeks, I hope to be able to do it satisfactorily. Your friend and servant,

GEO. VAUX.

B. Silliman, Esq.

3. *American Andalusite.*

To the Editor.

NEW-YORK, Nov. 25, 1822.

Dear Sir,

I am much pleased to have it in my power to announce an American locality for well characterized *Andalusite*. I lately discovered in Litchfield, Connecticut, a group of irregularly aggregated crystals, the interstices being filled with granular quartz.

They are principally four sided prisms, nearly rectangular, varying in form to the rhombic. One of the prisms (being very perfect) has an acumination of two of the solid angles on the opposite ends of one of the diagonals of that termination of the prism which is in view. This acumination is formed by three converging planes of truncation, two of which cut obliquely the two lateral planes, and the other the terminal one.

The solid angles are thus replaced by three faces. There are no lateral truncations. The structure is foliated; the laminae of strong lustre; the color is bluish gray. The crystals translucent at the edges. Spec. grav. 32.

The Litchfield andalusite is so very analogous to foreign specimens in our cabinets, that it needs no further description. It is more perfect and beautiful, however, than any that I have seen. The largest crystal is in its diameter $1\frac{1}{3}$ inches by $1\frac{1}{4}$.

It appears to have come from granite, but there are no decisive indications of this particular.

Very respectfully, your obedient servant,

J. DELAFIELD.

To Professor Silliman.

4. *Observations on the BOLETUS IGNIARIUS, shewing its analogy to animal substances in closing its severed parts: by PROFESSOR EATON.*

TO THE EDITOR.

Sir,

Few persons take the trouble to watch the growth of Cryptogamous plants; therefore, accidental observations, may with propriety be preserved.

The *boletus igniarius*, or the common touch-wood is a very durable fungus. We often observe it full grown and generally several years old; but few persons, I presume, have observed its progress while in the growing state.

A fungus of this species first appeared, growing from the trunk of a decaying Lombardy poplar, in my yard, about twelve inches from the ground, in July, 1821. During that season, it grew to the extent of four inches in diameter. Last June it commenced growing again; and about the first of September following, it was fifteen inches in diameter, measured across the base of the semi-circle. The first season it approached a globular form; though it presented itself as an unfinished, rather shapeless mass. Now it has assumed its regular form, and seems to have completed its growth; which, if correct, proves it to be a biennial plant.

The most remarkable fact observed in the growth of this fungus was its flesh-like property, manifested when parts were severed. A deep gash was cut in its periphery in August; and the severed parts shortly afterwards united, by the process which surgeons denominate *first intension*. A piece was broken from another part, in the same month; and after lying on the ground two days; it was joined on again. The piece united, as in the case of the incision before mentioned, and continued to grow with the other parts of the fungus. Now there is not even a cicatrice nor any other evidence left of the incision or of the fracture.

Troy, Dec. 15th, 1822.

5. Notice of the Plumbago of Ticonderoga: by PROFESSOR HALL.

Middlebury College, August 27, 1822.

TO PROFESSOR SILLIMAN.

Sir,

I do not remember to have seen in the "American Journal of Science," any account of the Plumbago, Graphite, or Black Lead, found on Cobble Hill in the town of Ticonderoga. That which occurs in the vicinity of Roger's Rock has been frequently described. I visited the locality on Cobble Hill, last week. It is about three miles N. W. from the Upper Falls. The Plumbago is found in numerous places, on the south side of the hill, in deep veins, from one to eight inches in thickness. The veins are, generally, perpendicular to the horizon, and nearly parallel with each other. The gangue is graphic granite.

Near the summit of the hill, the plumbago is disseminated in all parts of the gangue, occurring, sometimes in small nodules, but oftener, in thin laminæ, exhibiting a brilliant metallic lustre. Some of the plates are very large. I measured one which was an inch and one twelfth in diameter. Among the gangue at the most elevated locality, is found a greenish stone, extremely hard, which in its external appearance, resembles Green Hornblende, but it is too hard for that mineral. I am at a loss what it is.

The graphite, in veins, is uncommonly pure. It occurs, here and there, in irregular, hexahedral prisms. I saw very little that was granular. Most of it is foliated. In a few instances, it appears to be *fibrous*; but, on examining it more closely, you perceive that the fibres, which are often long, running across the whole vein, are composed of narrow, thin laminæ. It is removed from its gangue by means of chisels, pick axes, and iron bars, and conveyed to the Falls, where it is pulverized and purified. It has been prepared for the market, chiefly by Guy C. Baldwin Esq. who informed me, that about three tons are disposed of annually. The average price, at which it is sold, is sixteen dollars a hundred.

6. *Notice of a curious Fluted Rock at Sandusky Bay Ohio.*

Extract of a letter to the Editor, from EBENZER GRANGER, Esq. dated

Zanesville, Ohio, July 2d, 1822.

In an excursion which I made last summer, I observed some most curious appearances on the rock at a place called Portland, or Sandusky city, on the Sandusky Bay.

The shore of the Bay at the town rises about eight feet above the water, and ranges nearly east something more than a mile, and then turns abruptly to the south. The rock appears to be what is vulgarly called bastard limestone. I do not know what it would be termed by Geologists, but its base is silex in fine grains strongly cemented with lime. It contains a great variety of shells, and is unquestionably a marine deposit.

In digging the cellars on the front street of the town, they come down, through four or five feet of earth, to this rock. Its position is nearly horizontal, with sometimes a trifling dip to the east, sometimes to the west, but more generally to the east. Its surface is fluted, with lines or grooves, in a direction nearly east and west, and though differing in width and depth, perfectly straight and parallel with each other. It appears to have been once polished as if by friction; and this polish it still retains in a considerable degree. I was told this rock had been examined by a scientific gentleman from England, who ascertained the direction of the lines to be, north 71 degrees east; agreeing exactly in this particular with a similar appearance, which, as he said, had been discovered in one place only on the old continent.

I examined the bottoms of a number of cellars, and found them similar. I also observed the same appearance in the rock on the shore; and in more than one place, I observed this fluted rock overlaid by another stratum of similar consistence. From the shore to the farthest cellar inland, in which I observed these impressions, must be more than one hundred feet, and I entertain no doubt that the impression, at some short distance farther, is overlaid entirely by another stratum: what its width is, therefore, it is impossible to ascertain.

At the shore of the Bay, where as before observed, it turns abruptly to the south, the fluted rock again makes its appearance, running in the same direction. Here the rock dips gently to the east, and disappears with the impressions under the water of the Bay. From the most westerly point where I observed the impressions, to this place, must be more than one mile, there can be no doubt that it is continued all that distance; how much farther west or east it may extend is unknown.

It has to me the appearance of having been formed by the powerful and continued attrition of some hard body. It resembled in some slight degree, the sides of a saw gate, (if you understand the expression) which has been for a long time rubbing against the posts, which confine and direct it. It was said to have been observed, by the gentleman before alluded to, that the cause of this phenomenon had been the subject of various conjectures in Europe; but that the better opinion seemed to be, that it had been effected by the operation of running water. Such an opinion, however, I think, could never have been formed, by one who had himself examined this appearance; for to me, it does not seem possible that water under any circumstances, could have effected it. The flutings in width, depth, and direction, are as regular as if they had been cut out by a grooving plane. This, running water could not effect, nor could its operation have produced that glassy smoothness, which, in many parts, it still retains.

7. *Extract from the Journal of the Academy of Natural Sciences of Philadelphia, Vol. 2d, Part II.*

Observations upon the Cadmia found at the Ancram iron works in Columbia County, New-York, erroneously supposed to be a new mineral. By WM. H. KEATING. Read Sept. 10th, 1822.

In the second number of the first volume of the New-York Medical and Physical Journal, Dr. Torrey has published a description and analysis of a substance, which he considered as a new mineral, and for which he proposed the name of green oxide of zinc; a specimen of this substance having been handed to me last spring, I immediately

recognized it to be similar in its nature and appearance, to a product of the iron furnaces of Belgium, which has been described by Mr. Bouesnel in the "*Journal des Mines*," (Vol. 29. p. 35,) under the name of Cadmia. Having had an opportunity of collecting on the spot* the most satisfactory proofs in support of my opinion, I beg leave to offer to the Academy the following account of this substance: It was first noticed at Ancram in the year 1812, when it was found in pulling down a stone wall connected with the iron furnace, which belongs to general Livingston, and is now under the direction of Walter Patterson, Esq. It excited some interest among the mineralogists of New-York, but no public notice was taken of it until lately. Mr. Bouesnel's observations on this subject are very full; these and a few short notes by Messrs. Collet Descotils, Heron de Villefosse and Berthier in the "*Journal* and *Annales des Mines*," are the only notices of it I have ever met with; I sought in vain for a mention of it in English works. The cadmia of Belgium is a new and rare metallurgical product, which is formed in iron furnaces about five or six feet below their orifice, and immediately under the charge; it there forms an annular disk or ring, which increases continually in thickness, and which, if not removed, would choke the furnace; it forms in the Belgian furnaces, according to Mr. Bouesnel, a ring of about sixteen inches in height, offering in the profile or vertical section, a curvilinear triangle, the base of which rests upon the sides of the furnace; and the apex which corresponds with its greatest breadth, is but little distant from the lower part of the ring, so that the triangle appears in some cases almost rectangular." I have seen a piece found at Ancram, which presented tolerably well the above described characters, and corresponded exactly with Mr. Bouesnel's description; like the European, it was found in tabular masses, presenting in many cases a distinct slaty structure. The substance has often a striped aspect; its color is grayish, inclining to yellow, green or black. The specific gravity of the European is 5.25, of the American 4.92; this difference is not very great, and may in part be accounted for, by the fact that the former

* These observations were made during a short visit to Ancram, in company with Mr. Vanuxem, who likewise, at the first inspection, recognized this substance to be cadmia.

contains a small quantity of lead, which varies from 2. 4 to 6. 0 per 100. 0.

The Chemical analysis of this substance made in New-York, has rendered it unnecessary for me to undertake that which I proposed making. I shall merely add a comparative view of the results of the analyses, made upon the European and American.

	Bouesnel.	Drappier.	Berthier.	Torrey.
Oxide of Zinc	90. 1	94. 0	87. 0	93. 5
———— Lead	6. 0	2. 4	4. 9	
———— Iron	1. 6	2. 6	3. 6	3. 5
Carbon	1. 0	. 5	. 6	1. 0
Silex, earths, sand, &c.	1. 8		3. 4	
	100. 5	99. 5	99. 5	98. 0

These analyses present a remarkable coincidence, except in the presence of lead in the European, and its absence in the American cadmia; but this difference is of no importance; in Belgium Mr. Bouesnel tells us that the iron ore is visibly intermixed with lead ore, and this accounts for its existence in the cadmia; we are also told that lead is found there in the furnaces below the metallic iron. It is not difficult to account for the presence of zinc with the iron ore, for in examining the ore bed at Salisbury, (14 miles east of the furnace) we ascertained that the hematite was found in the side of a hill, incumbent upon the shist and, as it were, incased in the decomposed part of it, and that the adjoining shist was very much broken up and altered; it does not appear that the hematite is the result of infiltration alone, for masses of micaceous iron ore are found connected with it, which appear to indicate that it results in part, at least, from the decomposition of oxidule or oligist iron ore. We know that this shist contains blende or sulphuret of zinc, in some places at least, as at the Ancram lead works, and this may account for the presence of zinc.

Mr. Bouesnel has endeavoured to explain the formation of these cadmia, in a manner which does not appear to me to be satisfactory, I would rather admit that it results from a reduction of the oxide or carbonate of zinc, which is intermixed in small quantities with the iron ore; that this reduction

takes place in the furnace; that the zinc sublimes and oxydizes as it rises, and settles in the form of a ring at the inferior part of the charge, where the temperature of the furnace is considerably lowered by the successive additions of cold ore, charcoal, &c.

This substance is not, it is true, found at present forming in the Ancram furnace; but this may in a great measure be owing to a better roasting of the ore, previous to its introduction into the furnace. It may also be occasioned by the circumstance that all the ore destined for Ancram is picked with great care, at the ore bed. I must not, however, omit to state that I found in the flue erected above the orifice of the furnace, for the protection of the workmen, a red, pulverulent substance, to which the workmen have given the name of *sulphur*, a name which, as the editor of the Emporium has well observed, has been most unfortunately given by furnace and forge men, to every product which puzzles them, and without any regard to its real composition: this powder I supposed to be a mixture of ashes and fine ore, blown out of the furnace by the rapid current of air; I conceived that if there was any zinc with the ore, it would be likely to be detected in this substance, accordingly I found by analysis, about eight per cent. of oxide of zinc, a quantity much greater than I expected. It would require a more accurate study of the progress of the furnace than I could make in two days, and a better knowledge of the methods formerly in use, to determine why cadmia are not formed there at present, as they were formerly. Dr. Torrey has, I believe, never visited Ancram, and the information which he received on the subject may have led him into error. For instance, he was misinformed (I think) when he stated, that "it was found when taking down one of the old walls of the furnace erected in the year 1744." We were told by Mr. Patterson, that it had never been found but in taking down a wall *connected* with the furnace, and which having been built after the furnace, may have contained materials which had been extracted from it at different times. This observation is of more importance than it at first appears; for if, as Mr. Patterson told us, the Ancram furnace was the first erected in the colonies of North America, or at least, the first in the province of New York, and if, according to Dr. Torrey, the cadmia had been found in the wall

of the first furnace erected, the substance must have pre-existed to any furnace known to have been erected there, which we think is not the case.

But, in addition to all the above mentioned proofs, and to those which might be drawn from the circumstance of its being found in the vicinity of a furnace, I have been able to obtain the evidence of men to the fact of its having been formed in it. Having been informed that ore from the same bed was used at the works belonging to Messrs. Holley and Coffing, near Salisbury, I repaired there with a hope of finding the cadmia near that furnace also. After a short search, I found it in its immediate vicinity, and was informed by Mr. Holley, that he had himself taken it out of his furnace about twelve years ago, when they renewed the stack. He was positive that it was the same; that it had been found about six feet below the orifice of the furnace, and that if not occasionally removed, it would have eventually choked it. I even understood him or his partner to say, that this substance was even at present occasionally formed in the furnace in pieces of almost one-eighth of an inch in thickness. One of the reasons why it is still formed at Salisbury, and not at Ancram, is probably owing to the ore used at Ancram, being picked and the other not. Mr. Patterson thinks his ore is also better roasted.

According to Mr. Heron de Villefosse, a similar substance is formed in the copper and lead furnaces of Julius, Sophia, and Ocker, near Goslar, in the Hartz. At Goslar, as well as at Jemmapes in Belgium, this cadmia is considered as the best material that could be used in the manufacture of brass; as it is purer than the roasted calamine, it is preferred to it, as well as to all other zinciferous substances. It had not, I believe, been used in Belgium before Mr. Bouesnel described it. Should it be found in any quantity at our furnaces, it would no doubt be equally advantageous to work it with copper for brass.

This substance has not yet been observed in many places. I believe the only spot where it has been noticed, in addition to the above mentioned, is at Verrieres, in France, where I discovered it in the year 1819.* I am inclined to

*As no account of the cadmia of Verrieres has as yet been published, I shall here add the note which I made on the subject in my journal. "July

think that if more care were taken by our iron masters, in observing the progress of their furnaces, and the products which they yield, it might be found in many other places; certainly it must have been formed in the old Franklin furnace, in Sussex county, New-Jersey, where so many fruitless attempts were made to work the Franklinite.

Before I conclude these remarks, I must observe, that it does not appear that the presence of zinc affects the properties of iron. In Belgium the iron is of good quality; and it is an interesting fact, that the bar-iron of Ancram is in great demand at \$120 per ton, a higher price than is at present paid for any imported iron. The castings from the Ancram furnace are in such a repute, that no other pigs are used at the West Point foundry for the heavy guns (32 and 42 pounders) now casting for the United States' navy.

The Ancram furnace equals, in beauty of workmanship, and economy of means, any that we have seen; and we entertain no doubt, that all works carried on with such admirable perfection, must and will always prove equally honourable and profitable to their owners and directors.

8. *Inflammability of Ammoniacal Gas.*

I have recently found that ammoniacal gas is much more inflammable than it is described to be in the books. Having filled with this gas, over mercury, some jars* which were eight inches long by two and three quarters in diameter, I found on bringing a pendent candle over one whose mouth was covered with a glass plate, which was withdrawn at the moment, that the gas burned readily as it rose through the

*The same that belonged to Dr. Hare's first deflagrator.

6, 1819. I visited the furnace of Verrieres, in the department de la Vienne, in France. The director mentioned that his ore was good, and that the iron it produced was likewise good. He complained, however, of a substance which formed in the furnace, five feet below its orifice; it was in the form of a ring. It would, he said, have choked the furnace if not removed, which at times was a difficult undertaking. I mentioned to him that it appeared to be analogous to the cadmia of Belgium. The specimens which I took with me were heavy, compact, and of a dark colour."—I have not had an opportunity of analyzing them since; but my suspicions on this subject were confirmed, when, on returning to Paris in the autumn of 1820, I was informed that the Engineer of mines De Cressac had discovered calamine in that vicinity the year before.

air, exhibiting a voluminous yellow flame. The reason why, in common cases, it appears nearly unflammable, is, that it is used in very small quantities, and in narrow vessels, into which the common air can, at the moment, scarcely enter, and the gas is not sufficiently inflammable to burn (like pure hydrogen,) merely at the surface of contact, at the mouth of the vessel. But if it rise through the air suddenly, in large volumes, and in its ascent, strike the flame of a candle, it is then sufficiently inflammable to be seen through a large room, and forms a handsome experiment.—*Editor.*

9. *Crystallization of Sulphuric Acid.*

It is very well known to every chemist, that sulphuric acid, diluted to about 1780. water being 1000. readily congeals and crystallizes with a moderate cold. It is also well known that this crystallization, when the acid is not fully concentrated, often happens spontaneously, and it is said, that even carboys of sulphuric acid have been broken by the expansion, resulting from the crystallization.

Having occasion, recently, to clean out a neglected carboy, which had been nearly emptied of its sulphuric acid, we found a few cubic inches of liquid in the bottom of the carboy, and on shaking it, to wash out the adhering sulphat of lead, (always found in the bottom of these vessels) we were surprised by the rattling, produced by thirty or forty distinct crystals of great size and firmness. On being withdrawn from the vessel, they proved to be *isolated crystals of sulphuric acid*; some of them were two inches in the greatest diameter; they appeared as firm as crystals of alum—were white and transparent, and their form, which, on account of their corrosiveness and their rapid deliquescence, it was difficult to examine, appeared to be that of very obtuse and flat rhomboids, like the lenticular crystals of calc spar—the *tête de clou* of the French.

It is evident, in this case, that the little acid remaining in the open carboy, had attracted water enough from the air, to bring it to the degree of dilution, which makes it crystallize most readily, and that the moderate cold which it experienced in a garret, in a mild night in November, had been sufficient to produce that result in the manner above stated.—*Editor.*

10. *Explosion of oxygen and phosphuretted hydrogen.*

The violent action of phosphuretted hydrogen and oxygen, of course, induces every demonstrator to be extremely cautious in bringing them together. Like others, I have been accustomed to permit a succession of single bubbles of phosphuretted hydrogen, to rise through a column of water, into a few cubic inches of oxygen gas, in the upper part of a bell glass, and thus to exhibit the splendid flashes of light, which are renewed at every contact of the gases. In some former years, explosions, attended, however, with no other injury than the breaking of the vessel, have resulted from the fact that, occasionally, a few bubbles of gas, probably less charged with phosphorus than others, have broken in the oxygen gas without exploding, thus producing, however, an explosive mixture, which a succeeding bubble, more highly charged with phosphorus, has kindled, and thus caused the whole to detonate.

At a recent lecture, the usual arrangement being established, a single bubble of phosphuretted hydrogen passed up into the oxygen, and, as I was afterwards informed by an observer, remained unbroken. The mouth of the retort was plunged not more than an inch and a half beneath the surface of the water, and this slight hydrostatic pressure, giving a little condensation to the gas, probably caused rather a larger volume of it than usual to pass into the oxygen, when the next bubble rose through the water. It is not probable that more than three common bubbles of the inflammable gas were mingled with as many cubic inches of oxygen gas, when a very bright flash of light, accompanied by an extremely violent detonation, ensued—shattering all the glass vessels in the vicinity, and projecting fragments of the bell glass in every direction, among an audience of three hundred persons, and to the extreme distance of forty feet, slightly wounding a large number of the spectators.

So sudden, violent and unexpected a result from so trifling a cause, appears to me worthy of being mentioned, as an inducement to the most scrupulous caution in the management of these violent agents.—*Editor.*

II. FOREIGN.

1. Dr. Borré's notices of European Continental Geology, with remarks on the prevailing geological arrangements in a letter to Dr. J. W. Webster of Boston—communicated by him—

To the Editor.

Dear Sir,

I send you the following extract from a letter I have received from Dr. Borré, whose essay on the Geology of Scotland has been so favorably received in Europe.

"I have been in the northern and southern parts of Germany and in the Hungarian empire. I have only room to tell you the principal results of my travels, without being able to enter into sufficient proofs of the correctness of my opinions, these you will soon learn through the medium of some of our public Journals. First, the primitive class of rocks contains two kinds of rocks, viz. *mica slate* and *gneiss*; no where, even at Freyberg is there a perfect *mantle shaped* stratification; the granite cuts the strata every where, and forms veins in it, it is in fact a posterior *Huttonian* rock, perhaps even of the transition period. There is certainly no decidedly primitive granite.

The transition class contains the slate formation associated with quartzose and chloritose rocks, and *grau wacké*. Some masses of Sienite have protruded through this formation, and nearly all the Sienites known, are newer than the *grau wacké*, or at least than a great part of it. This is generally acknowledged now at Freyberg as regards the Sienite of Dresden, Weissen, &c. To these Sienites belong the metalliferous Sienites of Hungaria which contain small veins of silver and gold, and are also impregnated with these metals. Most of the metalliferous veins seem to belong to the same age, and to have been filled in part from below and in part from above. Every where the theory of Werner is in fault, even at Freyberg it is falling down rapidly, now that its author is dead.

In the latter part of the transition series are masses of limestone, of coral banks, and of *Huttonian* masses, or layers of greenstone with augite. (The encrinal limestone of

England is a deposit of this kind, alternating with the oldest part of the 1st floetz limestone of Werner.) The transition class ends with the porphyries, or the secondary class commences with them. The porphyries and trap rocks (which Dr. B. considers as local igneous formations) appear very differently in many places. In Cumberland, and the Fichtelsgebirge the grau wacké contains masses of porphyritic and trap rocks, beds of reaggregated rocks of this class, with here and there masses of Sienite or sometimes hillocks, often containing hypersthene, or diallage. The superior and inferior surfaces of these masses are often scorified—some cavities appear to have been filled up by infiltration.

In some countries the porphyries have broken out of the primitive schistose rocks, and now form dykes with hillocks of porphyries and of reaggregated porphyritic masses. In some places, as the Erzgebirge, they are mere dykes, as these were once taken for the beds of porphyry in the gneiss, on the contrary gneiss contains no beds of porphyry, and even the greatest part of the beds of granite in gneiss are only veins, as for instance in Sweden and Finland.

In the Erzgebirge, the dykes have much altered the gneiss, and it appears to have been also affected by acid vapors. Sometimes you see below the gneiss or transition clay slate the porphyritic matter, having every appearance as if it had been thrown up from below, and in some places you observe crystals of pyroxene in the gneiss where it is in contact with the dyke.

The coal formation is found *upon* the old red sandstone in Scotland, and Silesia; at Thorandt near Dresden and at Halle it is *below*, and in Bohemia it is *in* the old red sandstone.

On the Rhine and in the northern parts of the Alps, the Zechstein or 1st floetz limestone is imbedded in the coal-field. I explain this in the following manner; the old red sandstone is only a conglomerate of porphyritic matter, when the porphyries have appeared sooner as a local deposit, you find the coal field above the sandstone; when they have appeared during the deposition of coal, the coal field is covered by the sandstone, and when they have appeared through the whole period, there you find hardly any of the sandstone of the coal formation, but the coal field is *in* the old red sandstone. On the other hand where no porphyries

have appeared, the old red and *coaly* sandstone are more like *grau wacké*, and a sandstone distinguished by the small remains of vegetables. Such is the composition of the old red sandstone of the northern part of the Alps.

On the south side of the Alps, porphyries abound under the limestones, with the old red sandstone. The Zechstein is there separated from the sandstone and alternates with the rocks of the coal formation. When the porphyries have appeared late, and the old red sandstone presents itself below the coal, there is a great deposit of *red ground* or second floetz sandstone, as for instance in the Vosges, the Hartz, &c.

In Germany, you find above the old red sandstone, the Zechstein more or less compact, porous and magnesian with *Flustræ*, *Terebratulæ* &c. it is truly the magnesian limestone of England with the same organic remains. It also contains the ferriferous limestone of the Germans and the *Hohlenkalk* of the Thuringewald. This limestone exists in France, also. Above this rock is the *red ground* or variegated sandstone, it is the common repository of the salt. In the upper part there are sometimes beds of oolite belonging to the *muschelkalk* or second floetz limestone which lies every where upon this *red ground*. This formation is characterized by its compactness and by its encrinites, terebratulites and pectinites, it is very abundant in Germany—it is found in the north east part of France, at Nevres &c.—it is unknown in England.

Above the last is the *Quadusandstein* or third floetz sandstone, which is also wanting in England; it exists also here and there in France. It is whitish, yellowish or brownish, and sometimes ferruginous; it rarely contains mineral charcoal, pit coal, bituminous wood, impressions of monocotyledons and branches of trees. Pectinites, turbinites, bivalves, strombites, and gryphites are often found in it. Above this is the Jura limestone or third floetz limestone, the superposition is seen in Suabia, Westphalia and France. In England, the Jura limestone includes all from the Lias to the Iron sand. In the true Jura chain, the second floetz limestone appears, here and there, under the Jura limestone, as near Basil. The Jura limestone is sometimes divided into first, marles with the *gryphite* limestone, as in the island of Sky and in Ireland, second, into compact and oolitic limestone, third, into limestone with many organic remains (at

Pappenheim, Eichstadt and in part of Normandy.) It is distinguished from the second floetz limestone by its *turreted* form, &c. The green sand is abundantly distributed in Germany, above the Jura limestone, and also in Bohemia where it forms the *Räuerkalk*; it abounds in Westphalia near the Hartz; it is some times full of hydrate of iron as in Moravia, in some parts of France, on the borders of the Hartz, in Pavonia, &c. The chalk is abundant in Polonia, above the green sand, with all the preceding members, and also here and there in the north of Germany, especially near Padesborn in Westphalia. Above the chalk is the *plastic* clay with sand and rolled masses, forming a great part of the extensive alluvial tract south of the Baltic; it here and there contains shells. In the north of Germany you rarely see the coarse *marine limestone*, but in the southern parts in Hungary, &c. it is associated with the *plastic* clay, or at least you observe there, a *nagelfluch* with a shelly limestone, plastic clay with bituminous wood and fresh water shells, clay with many marine shells like those of the subappenine hills, sand, a kind of coarse marine limestone with shells which do not exist in the limestone of *Nagelfluch*, and above these are fresh water deposits of different ages with *Planorbis*, &c. At Pest it is very compact, at Vienna marly, at Baden tufaceous. Near Nicolshitz in Moravia it contains insects (diptues.) Basaltic deposits are abundant and *true volcanoes with craters and scorix* exist at Egen, at Hof and in the Reisingebirge, ancient sub-marine accumulations of lava and tuff are frequent in Germany, and the scorix are often infiltrated. The dykes are numerous and have produced an evident alteration in the rocks adjacent. Basaltic cones, elevated as explained by the Huttonians, not by the volcanists, or in the form of streams, are met with here and there, especially in Hessa, and the *red ground* and shelly limestone are much altered in their vicinity and present the same black aspect as at Sky and in Ireland.

Trachytes are seen in five places in Hungary, on the borders of the Rhine, and in Stiria. They may be divided into five varieties. Trachytes existing in hills. Trachyte porphyries (*couleês*.) Porphyry more or less vitreous (a kind of *couleês*.) Silicious porphyries, probably consolidated by water, and having been once pumice-porphyries. Trachytic and pumaceous tufas (being reaggregated matters

of the age of the coarse limestone of the Parisian formation."

2. *Mineralogy of the Island of Ceylon.*

A letter reached me, a few days since, from the Rev. Miron Winslow, American Missionary in the East-Indies, dated Oodooville, (Jaffna,) Jan. 11, 1821. It contains a number of facts, relating to the mineralogy and geology of Ceylon, some of which, I suspect, are not generally known to the readers of your valuable work. I therefore copy a large part of the letter, and send the transcript to you for examination; and, if you think it of sufficient importance, for insertion in the "American Journal of Science and the Arts," please give it a place.

Yours truly,
FREDERICK HALL.

PROF. SILLIMAN.

Middlebury College, 27th August, 1822.

"I earnestly wish that by delaying so long I could now say something as satisfactory to my own mind on the other subject,—that of the mineralogy of this Island. I did hope, in accordance with your request, to be able to send you some specimens of the *precious* stones, at least; but have as yet entirely failed in my attempts to obtain any; and had I obtained them, should have found it very difficult to forward them from this corner of the Eastern world, which has very little communication with any other part of India. In coming to the Island we first landed at Trincomale, and afterwards at Point De Galle and Colombo, at all of which places I tried to obtain specimens; but could find none except at Galle, and there only in the hands of the jewelers, who demanded a great price for them. The precious stones are found only in the interior of the Island; and as very few here pay attention to science of any kind, there have been no considerable attempts to explore mineralogical treasures, that might be there found; and no cabinets of minerals have been formed from which one might borrow. A Society has lately been instituted at Columbo, called the "*Ceylon Literary Society*," which promises to do something in this way: and I do not despair of being able hereafter to give you a better account of the mineralogy of this Island than I now can.

"As far as my sources of information (which perhaps are not as good as your own,) enable me to state, I can say, that compared with most parts of the world, the precious stones in Ceylon are numerous; but not of a particularly fine quality. The ruby, the topaz and the diamond, are said to be much inferior to those of Brazil and Golconda; and the tourmalines here are destitute of electric qualities. Without pretending to any thing like an enumeration of all the minerals, I shall mention some of the more important, and their classification according to the Wernerian system. I.

Diamond Genus. 1. Diamond. This is inferior to the diamond of Golconda, or the Coromandel Coast, which is better, even than that of Brazil; but, like the former, I believe crystalizes in Octahedrons, and exhibits all the varieties of that primitive form. II. *Zircon Genus.* 1. Cinnamon stone. I have seen several specimens of this, but am able to say nothing of its comparative qualities. It is rather common, I believe, in the interior. 2. Hyacinth. This is of a reddish color—may be rendered white by fire, and is then called *Jargon*. It is heavier even than the diamond, and like that, exhibits but one refraction, which indeed is common, I believe, to most of the Oriental stones.

III. *Flint Genus.*(a) *Garnet Family.* 1. Garnet. They are of different shades of red; and are magnetic.(b) *Ruby Family.* 1. Sapphires, blue and green, and heavier than those of Brazil. 2. Ceylanite of which I know only the name. 3. Topaz. This assumes the Octahedral form.(c) *Shorl Family.* 1. Emerald. The Emerald of this Island is, I believe, fine. 2. Shorl. 3. Tourmaline. The constituents are alumine, 50. silice, 34. lime, 11. iron, 5. It is said not to be electric, but I cannot answer to the truth of it, especially as I know it is usually reckoned as electric, when heated to 200° of Fahrenheit.(d) *Quartz Family.* 1. Quartz—Amethyst. 2. Rock Crystal, (black and white.) 3. Carnelian. 4. Opal. (1 species) 5. Cats-eye. This has a point, near the middle, from which greenish traces seem to proceed, in a circle. It is rather plentiful. Of the metals, lead, tin and iron ore are found in the interior; the latter only is wrought, and on a small scale. The natives have long been accustomed to work small quantities of the ore in small fires made by the operation of hand bel-

lows; and lately, an attempt has been made by Government to establish a forge in Handy.

Of the above minerals, and of almost all others, indeed, the part of this Island which we occupy is entirely destitute. The District of Jaffna is a perfectly level bed of sand, sometimes of a clayey order, on a continued substratum of a Coral. This species of stone (if it may be called such,) is almost the only one in Jaffna. In those parts of the District where the land is higher and drier, there appears occasionally a kind of stone, a little resembling, at first sight, the limestone; but which, on examination, seems to be composed principally of alumine, with an addition of silex and, perhaps, a small part carbonate of lime. It is of a greyish color, very hard and brittle, without any grit. Wherever found, it is evidently worn by the attrition of the waters, the surface being generally very smooth, but uneven, and in case of any thing like a considerable stone or rock, it is full of holes, and sharp points, as one would expect to find in stones, subjected to the action of falling water. Indeed, there is no want of evidence, that the whole of the District has been redeemed from the sea, and some part of it, at no very remote period. The land is all evidently of secondary formation. In many places near the sea, it is still nothing but a confused mass of coral and sea-shells, with a small mixture of common earth. This is particularly the case on the southern and western shore, where the water is very shallow, and discloses at the bottom increasing beds of coral, which threaten still greater encroachments upon the sea.

What is here called (improperly enough perhaps,) "*Coral Stone*," appears to be a calcareous formation from coral or coralline, broken and reduced by various degrees of attrition, until it is deposited, with other marine substances, in layers of different consistence, resembling stone. It is light, spongy and easily cut with the axe or saw, but when taken from its watery bed, and exposed to the air, it hardens so as to form an excellent material for building. It is burnt for lime, and when the proportion of shells in its composition predominates, it forms an excellent cement, superior to that of the limestone of our country. The coralline, which goes into the composition of this stone, is of the most ordinary kind. It grows in the shallow waters all

self, having the animal in my possession an hour, and the description is from my own observation, taking minutes at the time. I regret it is not in my power to give a scientific description, but you must use these facts for that purpose, and lay it before the Society of which you are a member. I offered for it \$1000, which was as much as I dare risk. I have heard the animal is taken to Europe, where it is probable a particular account of it will be published. Until this came under my observation, I was a disbeliever in the existence of an animal inhabiting water, so much resembling a human being. *Now* I am convinced—I was only disappointed in its size. I had conceived the idea they were much larger, if they existed at all.

Its extreme length from head to tail, 27 inches. Arms, including hand, $13\frac{3}{4}$ divided thus, $8\frac{1}{4}$ from end of finger to elbow—from thence to shoulder $5\frac{1}{2}$ —the hands beautifully formed—fingers tapering and nails long, delicate and white, projecting a little beyond the flesh—it is a female, and from every appearance, full grown. The breasts were of good size, resembling those of a human being, and were relatively situated—immediately under them, commenced the fish.

The head large in proportion, of human form, rather round—the hair upon it coarse and black—most upon the right side—the other appeared inclining to baldness, cheeks project nearly in a line with the nose, which is perfectly human, rather flat, and with large nostrils. The ears were human, and properly placed—there is a little hair down the back of the neck to where the shoulders set on—eye sockets rather large—the head was so set. that its vision when prostrate was at about an angle of 45° upwards—which as you hold it erect gives it the appearance of a hump-backed person. The neck finely formed, rather long, and upon the *Adam's apple*, a small lock of hair. Lips human—mouth large, and the eye teeth were like tusks—the others were like those of a human being. The line of demarkation between the fish and woman, is at the commencement of the scales immediately under the breasts, where the scales are so fine, you can only see them with a powerful magnifying glass—they gradually increase in size as you approach the tail, where they are little larger than those of a haddock, and adhere firmly. The skin above, was evidently smooth and

tawny. Just under the breasts are two fins, quite small, and above them, say $\frac{1}{4}$ to $\frac{1}{2}$ an inch, a lock of hair. Between the fins and hair, commence the scales—below these, 7 inches, are two others larger than the upper; and lower, one long fin extending nearly to the tail—on the back one long fin just over the two middle ones upon the belly. The outer edge of the fins appear to be of a reddish hue—the backbone shows itself from the neck down to where the scales commence, and is there lost to the sight. The first part, if I recollect right, resembles in its fins the fish of our shores that feed upon the rocks, and is of a dun color. In what position it gives suck I am at a loss about; but am inclined to think, prostrate upon the rocks. I learned from the owner, that the Japanese say they are often seen, but are very wary. This is miserably preserved, having shrunk much, and to accommodate it to a box six inches shorter than the first—they ingeniously bent its tail which cannot now be straightened.

JOHN SHILLABER.

4. *New edition of Parkes' Rudiments and Chemical Essays.*

'We hear that Mr. Parkes, the author of the Chemical Catechism, has in the press a new and enlarged edition of the Rudiments of Chemistry, printed on fine paper, in a larger size than before, and with newly engraved plates; and that he is also printing a new edition of the Chemical Essays, much enlarged, and with a great part re-written. We understand it was to be published before Christmas, in two thick octavo volumes, with a great number of copperplate engravings, many chemical tables, and a very copious index to the whole. These Essays have been published in French at Paris, and in the German language at Weimar—and a new translation in German is now printing at Leipsic.'



Foreign Literature and Science.

Extracted and translated by Professor Griscom.

5. *New work on Fossil Shells.*—A work in one volume 4to. with eleven lithographic plates, price 12 francs in boards,

on the natural history of fossil shells, has been published in the present year by those able mineralogists, A. Brogniart, and A. G. Desmarest. It is entitled, "*Histoire naturelle des crustacés fossiles sous les rapports zoologiques et géologiques ; savoir, les Trilobites, par M. A. BRONGNIART, membre de l'institut, et les crustacés proprement dits, par M. G. A. DESMAREST, professeur à l'École d'Alfort, &c.*"

6. *A New Journal of Natural Science* has been commenced at Copenhagen, under the editorship of professors Ærsted, Horneman, and Rheinhardt, and Dr. Bredsdorf.

7. *Color of Sea Water*.—The color of the polar seas presents various tints from intense blue to olive green. These tints do not depend on the state of the air, but solely upon the quantity of water. They are divided into bands of various shades, in which whales are more frequently found than in all other parts of the sea. It has long been thought that those greenish waters take their tint from the depth of the sea. Captain Scoresby however, has discovered in these waters by means of a microscope, a great number of spherical globules, semi-transparent, accompanied by detached filaments similar to small locks of very fine hair. These globules are $\frac{1}{1720}$ and $\frac{1}{1730}$ of an inch in diameter, and on this surface are 12 nebulosities, composed of brownish points, in 4 or 6 pairs alternately. He considers the globules as animals of the genus *Medusa*. The filamentous substance is composed of parts which in their greatest dimensions, are $\frac{1}{1710}$ of an inch. Examined by the most powerful lens each filament appears to be a chain of moriliform articulations, the number of which in the largest filament is about 300. The diameter is not more than $\frac{1}{17300}$ of an inch. Though these substances appeared to change their aspects, captain Scoresby could not determine whether they were composed of living animals, having the power of locomotion; but he is convinced that it is to the presence of these microscopic beings that the polar seas owe the various tints of green which are observed in them. He calculates that one cubic foot of this water may contain 110,592 globules of these *Medusæ*, and a cubic mile about 23,888,000 hundreds of millions. He supposes that these animalculæ furnish nutriment to the *Actinia sepiæ*,

Limax and other molluscs very abundant in the polar seas, whilst these in their turn, are devoured by the various species of whales that inhabit the same regions.

8. *Abbeville department of Somme France.*—*Fossil remains.*—There have just been found in several sand pits in the neighbourhood of this town, the bones of Elephants and Rhinoceros, Stag's horns, and teeth of a carnivorous animal which M. Traulè of that town regards as those of the Lion. These remains have been found at the depth of twenty-five feet detached and mutilated. They consist of an elephant's tusk, an atlas and a metatarsus of the Rhinoceros. The enclosure of these fossils is a bed of *sharp grained sand*.

9. *Singular disease.*—The workmen of a cotton manufactory at Argues, near Dieppe, were attacked in the beginning of February last with nausea, vertigo and convulsions, which so much affected their imaginations, that they thought they saw spectres and other fantastic objects flying at them and seizing them by the throat. The Doctor not being able in time to calm their troubled brains, the villagers and country people did not fail to declare according to custom that *it was owing to a spell that had been cast upon them at the manufactory*. A thousand ridiculous ceremonies were performed to make them believe that the spell was taken off, in order to calm the imaginations of the affected. But this remedy served to confirm an extravagant prejudice and produced only a temporary effect. It became necessary to have recourse to threats, and the fear of being dismissed and thereby losing their means of subsistence, tended at length to restore them to reason.

A memoir on the causes of this malady has been presented to the medical society of Dieppe by M. Nicolle, an apothecary of that town, which contains a very exact and curious recital of the distinguishing traits of these spasmodic affections. The author attributes them to the gaseous oxide of carbon, resulting from the decomposition of the oil by the heat of a cast iron stove on which they were in the habit of placing their vessels of that fluid. This gaseous product as it is well known, is lighter than the atmosphere, and in this way the author accounts for the fact, that it was in the upper stories of the manufactory that the people were first affected

while those on the ground floor were generally preserved from it.

10. *The preservation of Potatoes* has been lately held up to view in France, as the best security against famine. An account has been given by Cadet de Vaux, of an establishment of M. Ternaux at Saint Ouen, for the economical preservation of grain, potatoes, &c.

The potatoes are pared, (the parings being given to hogs and other animals) boiled in steam, spread while hot upon a table, divided by a light instrument, which enables the moisture to evaporate, cooled, and then passed through a granulating sieve, and thoroughly dried in a stove, constructed advantageously for this purpose. The dry material when taken from the stove has the form of vermicelli. It may easily be reduced either to coarse or fine flour, by grinding. It is called by M. Ternaux *polenta*, and requires nothing but a little warm water and salt, to convert it immediately into an agreeable and savoury potage. Two table spoonfulls, which cost only the hundredth part of a sous, are sufficient to make two plates of soup. When added to bouillon, no time or preparation is necessary, and it is superior in this respect, to vermicelli or flour.

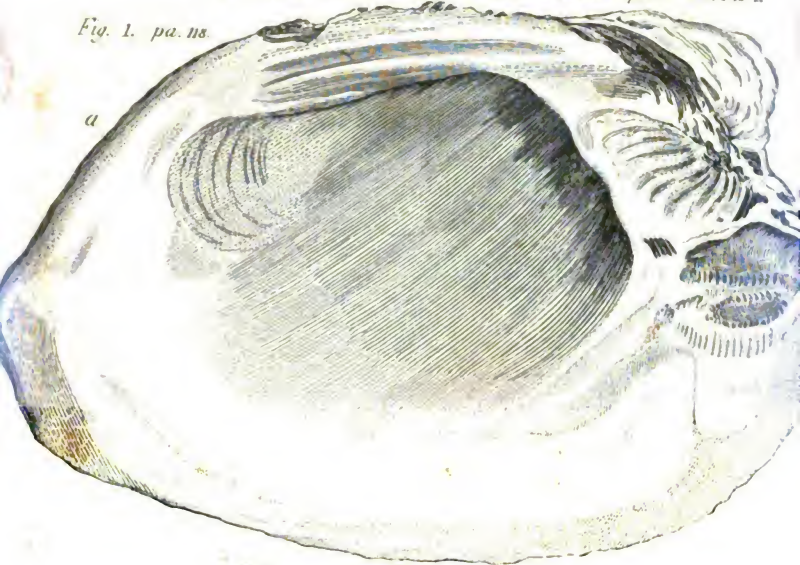
At Moulins, 550 individuals reduced to want, were fed during 18 months at the rate of two centimes and a half, (about $\frac{1}{40}$ of a cent) per day. This Polenta, and the gelatine of bones, are in the art of beneficence, a true philosopher's stone. We may therefore apply to the Potatoe an observation we have seen in *les annales Européens*, "A single vegetable, when its importance comes to be properly appreciated, may work an entire change in the fortune, the habits, the enjoyments, and happiness of a people."

11. *Zodiac of Denderah*—This remarkable and curious specimen of antiquity, transported with so much labor and expence from upper Egypt to Paris, has been purchased by the King, and will be placed in a suitable position in the Louvre.

Mr. Griscom's communications on foreign literature and science, excepting the above articles, came too late for insertion in the present number; the remainder are unavoidably deferred.

EDITOR.

Fig. 1. *pa. ns.*



Unio Crassus

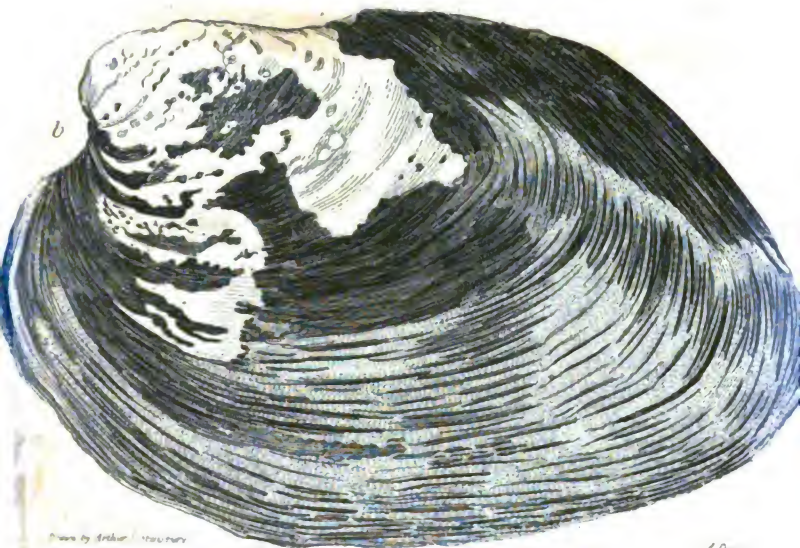
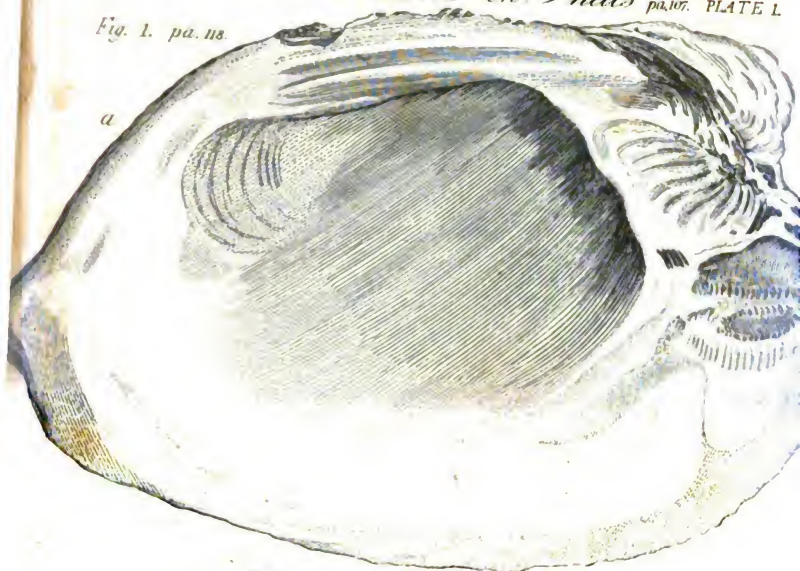


Fig. 1. pa. 113.



Unio Crassus

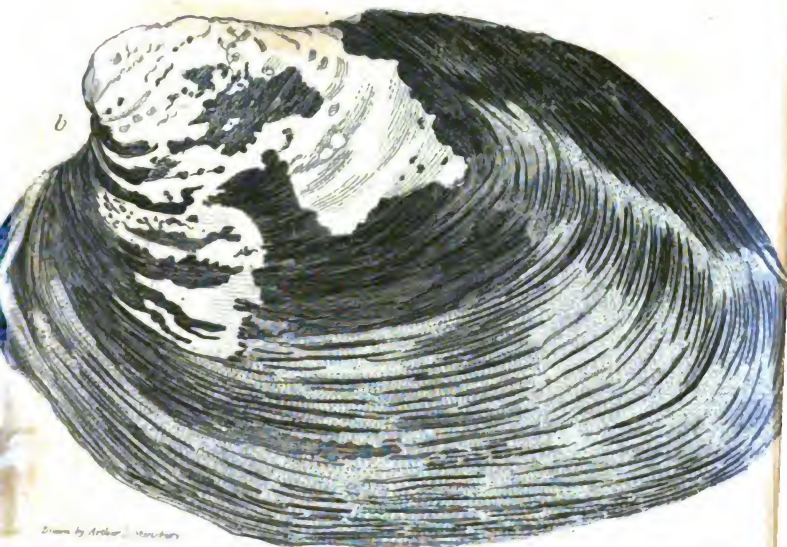
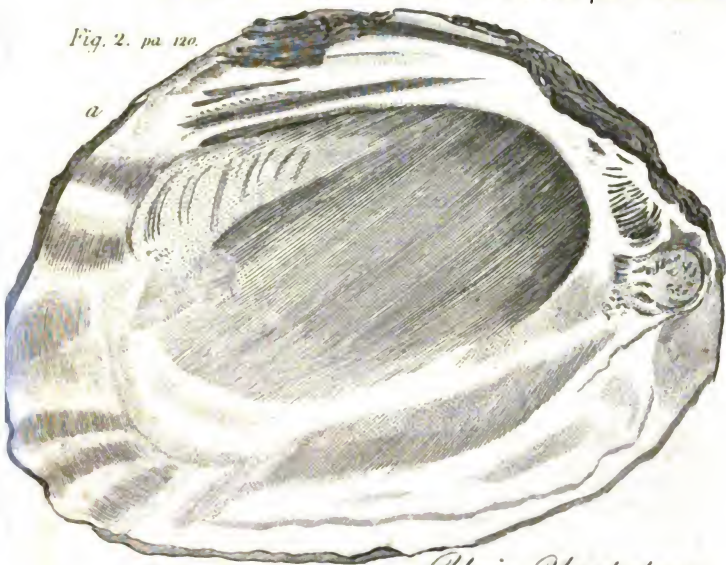


Fig. 2. pa. 120.

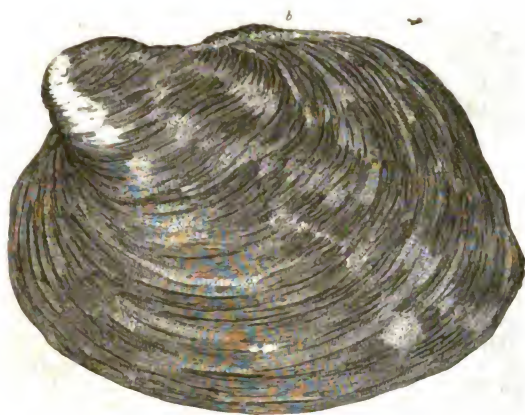
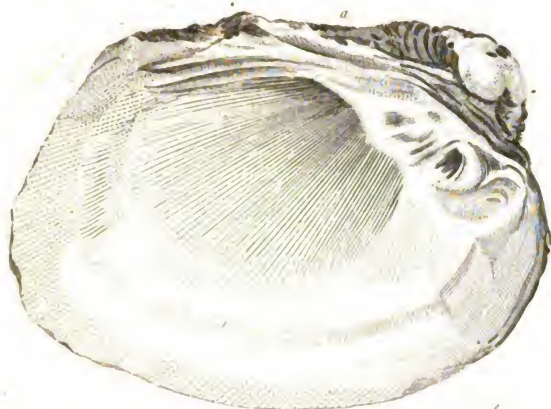


Unio Undulatus.





Fig. 3. pa. 120.



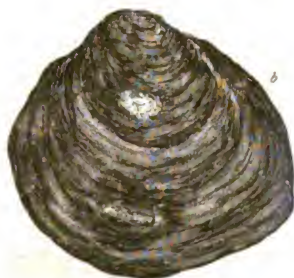
Unio Micatus.

Drawn by Arthur I. Standen

A. Nichol

Fig. 3.

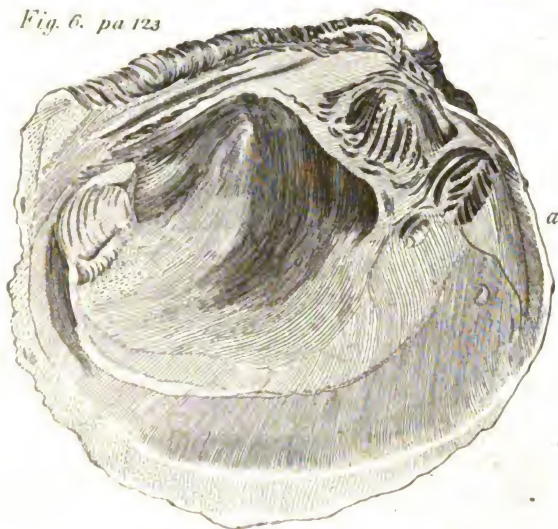
Fig. 4. pa. 121.



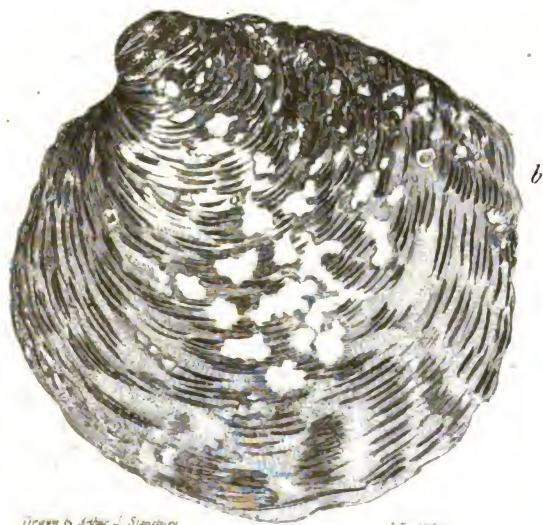
Unio undatus.

Unio cornutus.

Fig. 6. pa 123



Unio Verrucosus



Drawn by Arthur J. Stanbury

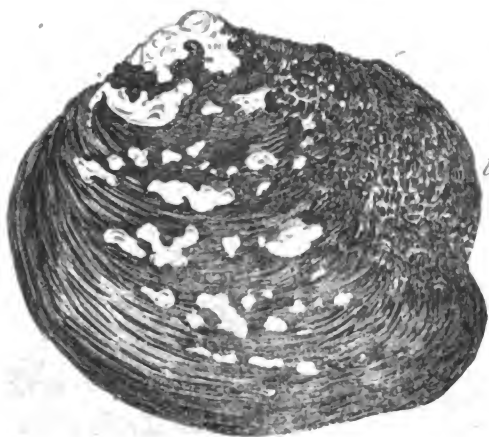
A. Dardaine sc.

U. Barnesi (P. 124)

Fig. 7. pa. 124.



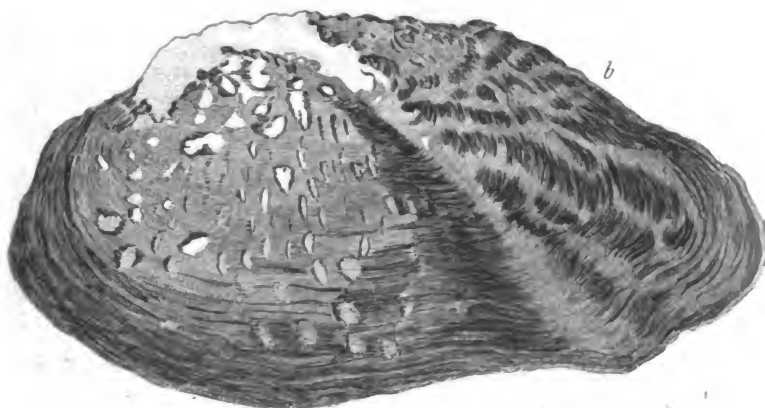
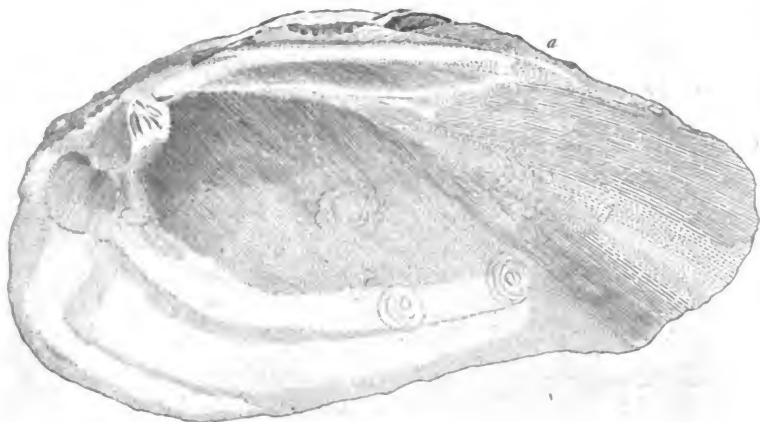
Unio nodosus



• Drawn by Arthur J. Stansbury

A. Peck.

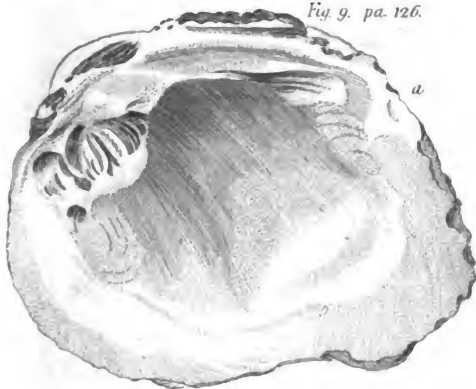
Fig. 8. pa 125.



Unio Tuberculatus

79

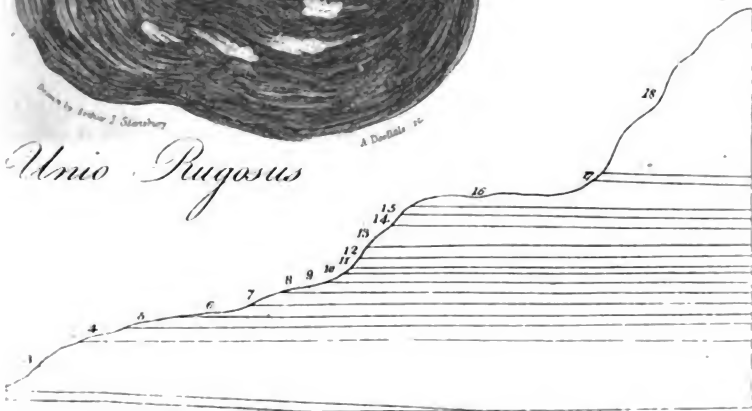
Fig. 9. pa. 126.



Botrychium Simplex pa. 103.



Unio Rugosus



Section of Mount Toby & the strata beneath pa. 78.

Mr. Orr's figures

PLATE 9.

Fig. 1. pa. 134

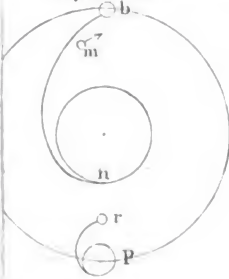


Fig. 3. pa. 140.

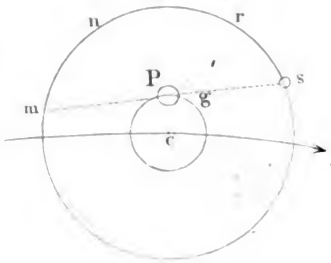
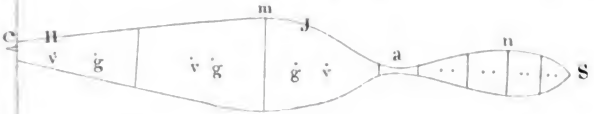


Fig. 2. pa. 137.



'rd veins in Sarcote pa. 14

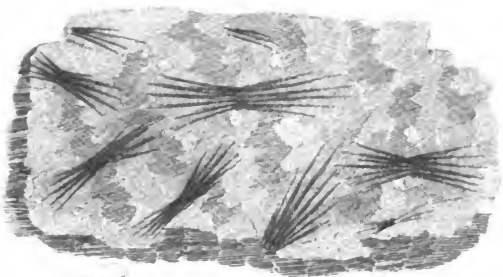
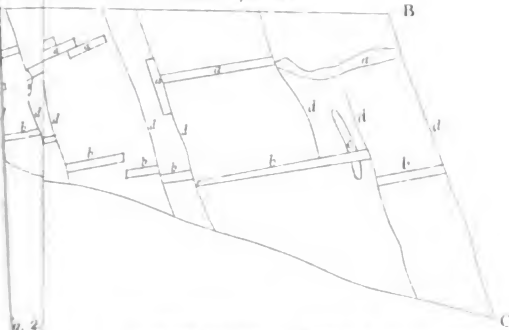


Fig. 4. Fasciculite of Mr. Hitchcock.

THE
AMERICAN
JOURNAL OF SCIENCE, &c.

GEOLOGY, MINERALOGY, TOPOGRAPHY, &c.

ART. I.—*A Sketch of the Geology, Mineralogy, and Scenery of the Regions contiguous to the River Connecticut; with a Geological Map and Drawings of Organic Remains; and occasional Botanical Notices. Read before the American Geological Society at their Sitting; Sept. 11th, 1822; by the Rev. EDWARD HITCHCOCK, A.M. of Conway, Massachusetts.*

PART II.

SIMPLE MINERALS.

Metallick Veins and Beds.

BEFORE giving a list of the simple minerals found along the Connecticut, it may perhaps be acceptable to the geologist, to present a short account of those veins and beds of ore, that occur in the district, which either have been, or may be wrought as mines.

1. *Southampton Lead Mine.**

This is a vein containing sulphuret, carbonate, sulphate, molybdate, muriate and phosphate of lead, with blende, pyritous copper, &c. The gangue is quartz, with sulphate

* For a description of this mine, by Professor Silliman, who examined it in May 1810, see Bruce's Journal, Vol 1. p. 63.

of barytes and fluor spar intermixed. The vein declines ten or fifteen degrees from a perpendicular; is six or eight feet in diameter, and traverses granite and other primitive rocks. It has been observed at intervals from Montgomery to Hatfield, a distance of twenty miles: but it is very doubtful, whether it continues, uninterruptedly, the whole of that extent; indeed, from what I have observed of other lead veins in the vicinity, I have sometimes been disposed to question, whether the veins observed at many of these intervals, may not be totally distinct from one another. In Southampton, eight miles south west from Northampton, is the only spot where this vein has been extensively wrought. In that place it has been explored thirty or forty rods in length, to the depth of forty or fifty feet, and the galena, which is the principal ore, has been found in masses from a quarter of an inch, to a foot in diameter. At the depth above mentioned, the water became so abundant, that it was thought advisable to abandon a perpendicular exploration, and to descend to the foot of a hill on the east, nearly eighty rods from the vein, and attempt a horizontal drift, or adit, and ever since its commencement, seven or eight years ago, the working of the vein has ceased. This drift is now carried into the hill, on an exact level, nearly sixty rods, and the workmen told me, that not less than 20,000 dollars had been expended upon it. The rocks that have been penetrated, reckoning from the mouth of the drift inwards, are gneiss, the red and gray slates of the coal formation, ("granulated schistose aggregate," *Eaton. Journal of Sci.* Vol. I. p. 136,) with thin beds of coal, and mica slate, and granite alternating. Probably the fundamental deposit of granite is now uncovered; and the principal vein of galena cannot be far distant. Several small branch veins of crystallized quartz and galena have been crossed; and several specimens of these, collected by Dr. Hunt, were very rich and beautiful; the crystals of pure galena sometimes exhibit, on their faces, insulated crystals of honey coloured carbonate of lime. The principal vein will be found not less, I should judge, than one hundred and fifty feet below the surface:—and when that time comes, it is confidently expected, not only that the proprietors will be rewarded for the great expence they have incurred, but, also, that many a rich specimen will be found to ornament the

mineral cabinets of our country, and to vie in beauty with the lead ores of Europe.

The mouth of this drift is four or five feet wide, and about three feet above the surface of the water. The water is deep enough, the whole length of it, to admit the passage of a loaded boat. The person wishing to explore this internal canal, must fire a gun at the entrance, or beat heavily with a sledge on the timbers that support the soil; in ten or fifteen minutes he will perceive a gentle undulation of the water, and soon after a boat advancing with lighted lamps and a rower; having seated himself on the bottom of this boat, and provided himself with an additional garment, he is prepared for his subterranean expedition. As he enters the passage, he will, for a moment, experience, or imagine he experiences, a little difficulty of breathing. But he will soon become reconciled to his condition; and after passing about one hundred feet in the excavation, for which distance the soil is supported by timbers, he will find occasionally more room, so that he can stand erect. If he looks back, after having advanced several hundred feet, the light at the entrance will appear diminished to the size of a candle; and before he reaches the extremity, it becomes invisible. About half way from the entrance to the end of the drift, he will pass a shaft; down which a small brook is turned, for the purpose of aiding the ventilator. When he reaches the end of the drift, he finds himself to have penetrated nearly sixty rods chiefly into solid rock; a voyage which although inferior to that performed in the celebrated navigation mine, in the Peak of Derbyshire, is still extremely interesting.

The miners do not quit the drift when they blast; but retire behind a breast work thrown up for the purpose. Entering immediately after an explosion. I did not perceive the air to be in any degree more oppressive than when powder is fired above ground. One man told me that he had been an inmate of that dark recess, eight or ten years, without suffering in his health, and when he returned alone into his dreary prison after conducting me to the day light, he struck up a cheerful song, indicating buoyant spirits and a contented mind.

Every mineralogist passing that way, will of course visit this drift. Intelligent gentlemen without professional views,

and even ladies not unfrequently enter this cavity, and find themselves amply repaid for their trouble.*

2. *Vein of Galena in Whately.*

This occurs in the north west part of the town, and I formerly supposed it a continuation of the Southampton vein. But the Southampton vein runs north east and south west, and this in Whately almost exactly north and south. Besides, the Southampton vein must turn almost at right angles from Hatfield, in order to be found in the north west part of Whately.

This vein may be traced at intervals one hundred rods, and extends into the edge of Conway. At the extremities it traverses mica slate; but in the middle, it cuts through an extensive bed of granite. Its diameter is usually six or seven feet, and the gangue is wholly common and radiated quartz. Galena, which is the only ore found in this vein, is disseminated through this matrix in considerable abundance. Very few efforts have been made to explore this vein, though appearances at the surface are not unfavorable; and if a horizontal drift were necessary, a deep valley within a few rods on the west, would afford a favourable opportunity for making it. As nearly as I could determine, this vein is not far from perpendicular to the horizon.

3. *Vein of Galena in Leverett.*

In the south west part of the town—traversing granite—only a foot wide—gangue, sulphate of barytes—deviation north and south—galena the only ore.

4. *Vein of Galena, Pyritous Copper and Blende, in Leverett.*

About two miles north of the vein last mentioned; and it may be a continuation of it. The gangue is quartz, united with sulphate of barytes; and the galena and pyritous copper are disseminated through it in nearly equal quantities.

*I have often thought Professor Cleaveland must have selected the appropriate motto prefixed to his Mineralogy, when entering this or some similar drift.

————— itumest in viscera terrae &c.

The blende is much less abundant. The vein is several feet wide, traverses mica slate and granite, and has been considerably wrought.

5. Lead Mine at Middletown.

I am unacquainted with the geological situation of this mine. I put it down on the authority of Professor Silliman in Cleaveland's Mineralogy.

6. Vein of Galena at Bethlehem.

I mention this on the same authority without any personal knowledge of it. It is, however, a little beyond the limits of the map.

7. Vein of Galena and Pyritous Copper in Southington.

Same authority—gangue, sulphate of barytes and quartz. I believe this vein occurs in the coal formation.

8. Mine of Galena, Blende and Pyrites in Berlin.

This occurs in greenstone, at its junction with the coal formation. The gangue is sulphate of barytes. The galena crystals are small; those of the blende larger; the pyrites is the least abundant. The vein is not now wrought. (Vide Dr. Percival's Notice, Journal of Science, Vol. 5. p. 44.)

Copper Mines and Veins.

It has already been mentioned, in the geological part of this sketch, that these ores (like the mine of galena &c. last mentioned,) exist along the junction of the greenstone with the coal formation. The veins frequently pass into both rocks, and are of various sizes and of frequent occurrence. Indeed, they may be found probably every mile or two along the line, where these rocks unite. A few of them, that have obtained some notoriety will be mentioned.

9. *Vein of Pyritous Copper and Green Carbonate of Copper, at Cheshire.*

In greenstone and associated with sulphate of barytes, quartz, carbonate of lime and sandstone. (Silliman in Cleaveland's Mineralogy, Vol. 2, p. 559.)

10. *Mine of the Red Oxide of Copper, Green Carbonate of Copper, &c. Granby.*

This is better known by the name of Simsbury Mines although it occurs within the boundaries of Granby. It was formerly wrought, but being at length abandoned, its shafts and galleries were converted into a state's prison. The mineralogist who explores this spot, must here contemplate the painful spectacle of almost every variety of guilt and crime. Sixty or seventy whites, mulattoes and negroes, scarcely distinguishable through filth, from one another, are here compelled by the point of the bayonet to labour at the anvil; while we read in their sullen and ghastly countenances, the inward workings of hearts rendered desperate by crime and punishment. As we descend into the shaft we observe the offensive recesses in the rocks, where these prisoners were formerly confined during the night. But only a few of the most refractory are now compelled to sleep in these damp and dismal dungeons; the government of Connecticut being satisfied that this kind of rigor served rather to harden than to reform the criminal. About seventy feet below the surface, the conductor pointed out to me a bolt driven into a wet rock, where, recently, one of the prisoners had been fastened for a week or fortnight, as an extra punishment for peculiar obstinacy; and where he lay, I saw scattered, the leaves of a bible, which, in his desperation he had torn in pieces:—thus spurning alike the laws of God and man!

If we judge from the present appearance of this excavation the original vein of ore must have been extremely irregular, forming *bellies* and *twitches*. It passes through the greenstone and enters the red and gray micaceous sandstone of the coal formation, which underlies the greenstone. All the varieties of ore I saw at the place were the red ox-

ide disseminated in sandstone, and mixed with a small proportion of green carbonate of copper. How productive this mine has been, I do not know.

11. *Vein of Green Carbonate of Copper and Pyritous Copper in Greenfield Mass.*

This is found on the west bank of Connecticut River, one hundred rods below the mouth of Fall river, and about the same distance in a direct line from Turner's Falls. It occurs at the junction of the greenstone and red slate of the coal formation, and passes obliquely into the hill of greenstone on the one side, and into the slate on the other in the bed of the river. The principal vein is five or six feet in diameter, and the matrix, toadstone, which is traversed, in the direction of the vein, by several veins of sulphate of barytes, which form *saalbandes*. The principal ore that appears at the surface is the green carbonate, the pyritous copper being rarer.

12. *A similar vein in the same township.*

About a mile below the vein just described, (down the stream,) is another, which I am told is very similar and therefore needs no description. In other places between these veins, I have noticed, in the red slate, veins of the green carbonate of copper, not more than a quarter of an inch thick, while the walls are glazed so as to resemble polished steel; constituting handsome specimens of the *Slickenside* of the Germans:

Mines, Veins, and Beds of Iron Ore.

13. *Micaceous Iron Ore in Veins, in Montague.*

Near the north line of the town, a little south west of the mouth of Miller's river, a granitic hill of considerable extent and elevation is traversed by veins of this ore in all directions; constituting one vast *stock werke*. The principal vein is nearly ten feet in diameter, and the gangue is quartz. I do not see why this ore could not be profitably wrought. See Journal of Science, Vol. 1, p. 438, where this ore is described under the general name of specular oxide of iron.

14. *Mine of Magnetic and Micaceous Oxide of Iron, in Haz-
ley.*

This exists in the north western part of the town, in beds, in talcose slate. The folia of the slate are nearly perpendicular to the horizon, and the principal bed of the ore varies from six inches to three or four feet in thickness, and numerous thin beds occur at the sides. The mine has been opened twenty or thirty rods long, and thirty or forty deep. The magnetic oxide is probably most abundant: but the micaceous oxide has not till lately been wrought, through an impression that it could not be smelted! One or two tons of it lie beside the mine ready for the mineralogist. I have never seen any ore of this sort, that will bear any comparison for beauty and richness of appearance with this. It has a schistose, gently undulating structure, and plates of it may be easily obtained, a foot in diameter, possessing a highly glistening aspect. But it is no very easy matter to get at this mine, on account of the extreme roughness of the country for several miles around it.

15. *Mine of Magnetic and Micaceous Oxide of Iron, in Ber-
nardston.*

This occurs in beds in talco-argillite, and is so similar to the last described, that additional remarks are unnecessary. I do not know to what extent it has been wrought.

16. *Vein of Micaceous Oxide of Iron, in Jamaica in Vermont.*

This exists in dolomite, and is very beautiful. It has been used as a substitute for smalt, and answers well. I do not know its extent. It is a few miles beyond the northern limits of the map.

17. *Mine of the Brown Oxide of Iron, in Salisbury in Con-
necticut.*

This, as well as the two following mines, occurs a considerable distance beyond the limits of the map. I merely mention them, however, because of their interesting nature; and

in giving a list of the simple minerals, I do not intend to be scrupulously confined to the region embraced by the map. This mine is wrought in a bed in clay. For further particulars see Prof. Silliman's account of this ore, in the *Journal of Science*, Vol. II. p. 212.

18. *Mine of the same ore, in Kent, in Connecticut.*

This is found, like the last, in a bed in clay. See Vol. II. of the *Journal of Science*, p. 216.

19. *Mine of Carbonate of Iron, in New-Milford, in Connecticut.*

This exists in a vein, in gneiss; and its gangue is quartz. See *Journal of Science*, Vol. II. p. 226.

20. *Bed of Bog Iron Ore, in New-Braintree, in Massachusetts.*

This ore is not uncommon along the Connecticut; but I have never examined a bed of it, except in New-Braintree, in Massachusetts. It lies in a valley, in a country of gneiss, only a few feet below the surface; and has been explored to a considerable extent.

21. *Mine of Arsenical Cobalt, in Chatham, in Connecticut.*

It exists in a bed, in mica slate, varying in width from a few inches to a few feet. The matrix is a mixture of hornblende and actynolite, in which the ore is disseminated. It was explored several years since, and has been again opened recently; the undertaking is now, however, abandoned. Arsenical sulphuret of iron, arsenical nickel, and arseniate of cobalt are found in this mine in small quantities.

22. *Mine of Bismuth, Silver, Argentiferous and Common Galena, Blende, Tungsten, Tellurium, Magnetical and Common Pyrites, Spathic Iron, Native Sulphur, Pyritous Copper, &c. in Huntington, in Connecticut.*

The various minerals mentioned above, have been found in a vein traversing gneiss, although it has yet been explored only a few feet in depth. The gangue is quartz. For a more particular description of this interesting spot, see various articles by Professor Silliman, in the first five volumes of the *Journal of Science*.

In the above enumeration several small and unimportant veins of ore have been omitted ; and probably many important ones are yet undiscovered. In some instances I have met with men who profess to have found beds or veins of ore, but will not disclose the spot, because they intend to render themselves independent by their discoveries. Indeed, were the mineralogist to pay attention to all he will hear on this subject in his travels, he would be led to suppose that every town, and even every farm, is a rich repository of metals. For he will often be told, how in such a mountain the aborigines used to obtain iron, lead or silver; or how, in such a place, the lightning frequently strikes, as a certain indication of metallic ores; or how in such a place *the mineral rod will work*; and a thousand such mummeries, by which honest but credulous men are frequently deluded, and sometimes ruined.

List of Simple Minerals found along the Connecticut.

I have already remarked, that in giving this list, I should not be confined precisely to the limits of the map; but where an interesting mineral has been found a few miles beyond these, I shall notice it. I shall annex to each species and variety, merely the localities and name of the discoverer, except in cases where I am able to add some particulars not heretofore published. To save all further trouble of reference, I have taken the second edition of Cleaveland's *Mineralogy* as a standard for names and arrangement. And, indeed, I feel as if a better disposition of minerals could scarcely be made, in the present state of the science, than that excellent work presents.

The species and sub-species are numbered in order from first to last. The varieties also, whenever they occur, are usually numbered.

1. *Nitrate of Potash*. Efflorescing on the soil under old buildings, &c.

2. *Sulphate of Barytes*. At Cheshire, Southington, Farmington, New-Stratford, and two miles from Hartford. (*Silliman*.) Also at Berlin. (*Percival*.) Also at Hatfield. (*Gorham*.) Also at Middlefield. (*Eaton*.) Also at Southampton lead-mine, at the Leverett lead veins, and at the Greenfield copper veins. At the three last mentioned places it is chiefly the lamellar variety.

3. *Calcareous Spar*.

1. *Crystallized*. At the Marble Quarry in Milford, in rhombic crystals; also in the lead mine at Middletown. (*Silliman*.) Also at the lead mine in Southampton, in limpid and straw-colored crystals on galena and quartz. Forms of the crystals. 1. A dodecaedron, composed of two six-sided pyramids, applied base to base. (*hog-tooth spar*.) 2. A short six-sided prism, terminated by three-sided pyramids. 3. The same, with all the solid angles of the prism truncated; forming a crystal of twenty-four faces. Also, in greenstone in Deerfield and Greenfield; and in a coarse limestone in Leyden, Conway, &c. in rhombs.

2. *Laminated*. At Milford Hills. (*Silliman*.) Also, in veins in greenstone, Deerfield.

4. *Granular Limestone*. At Milford Hill, embracing the bed of Verd Antique Marble. (*Silliman*.) In Wilmington, Vt.?

5. *Concreted Carbonate of Lime*.

1. *Calcareous Incrustations*. In the Coal Formation in Sunderland, &c.

6. *Argentine*. At Washington, Litchfield Co. (*Brace*.)

7. *Magnesian Carbonate of Lime*.

1. *Crystallized*. (Rhomb Spar.) Near New-Haven, with ab-
estus in Serpentine. (*Silliman*.) Abundant at the Milford
Marble Quarry. Also at Middlefield, in Soapstone. (*Dewey*.) Also at Southampton lead mine. (*Eaton*.)

2. *Dolomite*: At Washington and Milford Hills. (*Silliman*.) Also at Litchfield. (*Brace*.) Also at Middlefield. (*Dewey*.) Also at Jamaica, in Vermont. (*J. A. Allen*.)

8. *Brown Spar*. At Leverett, in a vein of galena, pyrites, copper and blende, grouped in rhombic crystals on quartz; the lamellae usually curved.

9. *Fetid Carbonate of Lime*. At Northford. (*Silliman*.)

10. *Bituminous Carbonate of Lime*. Near Middletown, with Ichthyolites. (*Silliman*.) Also at Southington, in the Coal Formation.

11. *Phosphate of Lime*.

1. *Apatite*. At Milford Hills. (*Silliman*.)

12. *Fluate of Lime*. Cubic and massive fluor spar occurs in Huntington—also chlorophane in the same place. (*Silliman*.) Also at Middletown, in the lead, &c. vein. (*Brace*.) Also at Southampton lead mine, green and purple. (*Gibbs*.) Also at Deerfield, crystallized in dodecahedrons? purple—in a loose stone, which contained also a crystal of galena. (*Cooley*.) Also at Putney, massive and grass green, forming a vein in bastard mica slate. (*Silliman*.) Also at Westmoreland, light green. (*Hall*.) Also at Conway, massive, light green, in small quantities in a vein in mica slate.

13. *Gypsum*. In amygdaloidal greenstone in Deerfield, in small quantities; "crystallized—white, and retaining its water of crystallization." Found by Dr. Cooley, and determined by Professor Silliman. This has been already mentioned in the geological part of this sketch.

14. *Sulphate of Alumine and Potash.* (Alum.) In Leyden, efflorescing on bastard argillite. Also in Conway, on mica slate.

15. *Common Quartz.*

1. *Limpid Quartz.* At Grafton in Vermont, remarkably pure. (Hall.) Also at Plainfield. (J. Porter.) Also in the veins of lead, &c. at Southampton and Leverett, and the copper veins in Greenfield, in six-sided prisms. At the latter place it occurs with both the terminations perfect. Also in veins in sienitic granite, at Northampton. Also in geodes in greenstone at New-Haven, Berlin and Deerfield. Also in veins and geodes from one to ten inches diameter, in mica slate in Conway. The crystals are of every size from one tenth of an inch to two inches diameter, and occur in vast quantities. In the same town fragments of crystals occur, as transparent as the quartz from Madagascar.

2. *Smoky Quartz.* At Torrington and Cornwall. (Brace.) Also at Plainfield and Brattleborough? amorphous.

3. *Yellow Quartz.* In crystals at the Southampton lead mine; of a honey yellow, resembling the Siberian topaz. The coloring matter appears to penetrate the crystals. Also in small quantities at the lead mine in Leverett.

4. *Rose-Red Quartz.* At Southbury, very abundant. (Silliman.) Also at Chatham and East-Haddam. (T. D. Porter.) Also at Deerfield; a single specimen in alluvial soil.

5. *Iris'd Quartz.* At Plainfield. (J. Porter.) Also at Leyden, in mica slate.

6. *Milky Quartz.* At Litchfield. (Brace.) Also at Cumington and Plainfield. (J. Porter.) The specimens that I have seen of this variety (and they are scattered abundantly over the mica slate region west of Connecticut river,) are rather poorly characterized, seeming to be intermediate between limpid and milky quartz.

7. *Radiated Quartz*. In the Southampton, Whately and Leverett veins of galena; in abundance. Also in Conway, in veins and loose masses.

8. *Tabular Quartz*. In greenstone, Deerfield—Lamellae usually applied to one another by their broader faces, and separating as thin as mica, but very brittle. Sometimes they intersect and produce cells of various forms. Also in Conway, in large loose masses among mica slate. Pieces more than a foot in diameter have been noticed, having both the structures above mentioned. The plates forming the cells are sometimes covered on their broader faces with minute quartz crystals. In some specimens there is a gradation from tabular to common amorphous quartz; the folia becoming less and less distinct, and finally disappearing.

9. *Granular Quartz*. At Vernon, Vermont, forming a bed in argillite. (J. A. Allen.)

10. *Pseudomorphous Quartz*. At the Southampton lead mine and in Deerfield greenstone—the impressions being cubical. At the latter locality also, a very curious variety of this mineral occurs. The quartz is the common limpid kind; passing, however, in some parts, into chalcedony; and it contains numerous cavities that diverge from a centre. Their form is that of a four-sided, nearly rectangular prism, generally a little flattened, and, of course, lessening to a point at one end. Their length is from half an inch to four inches. A complete sphere is seldom filled by them; usually not more than a quarter part of it; and at their outer extremity they are so scattered as not to fill half the surface of the sphere. I have sometimes observed these cavities proceeding from different centres, crossing one another. Although it is no uncommon thing to meet with these cavities, yet I have never found any mineral occupying them. An interesting question then occurs; by what were they once occupied? The probability is, that it was some variety of zeolite. Yet no zeolite of this description has been found in the greenstone in the vicinity. It exists in balls perfectly filled; the crystals usually circular, and the concretion never much larger than a musket ball. But the zeolite, it is well known, does occur in radiated masses several

inches in diameter, the outer extremity of which presents the form of the prism. I am rather disposed to believe that these cavities were once filled by a mineral not differing much from the Thomsonite of Dumbarton in Scotland.

Some varieties of quartz occur along the primitive region of the Connecticut that can hardly be referred to any of the preceding. Thus, there is a variety very abundant in beds and tuberculous masses in mica slate and argillite, which differs in nothing from limpid quartz, except that it is colored crimson red; and perhaps it ought to be referred to ferruginous quartz; but it differs from that commonly so called. Another variety is abundant every where, in large rolled masses, of a reddish grey color when broken, with a conchoidal uneven fracture—the structure being almost granular, and the aspect considerably like hornstone. Another variety, more rare, occurring in pudding stone, is of a light blue color, and scarcely translucent; but it can hardly be called the *blue quartz* of mineralogists. Another variety is found in granite and in loose masses, and is nearly black, and only semi-transparent. Another variety has a tinge of yellow—another of green, &c.

16. *Amethyst*. At Wallingford, Farmington, Berlin and East-Haven. Also at Mount Tom in East-Hampton. (*Siliman*.) Also in greenstone, Deerfield, forming geodes of a light purple; crystals from one tenth of an inch to an inch in diameter. Also in Westminster, Vermont, in crystals an inch and an half in diameter.

17. *Ferruginous Quartz*. At Litchfield. (*Brace*.)

18. *Fetid Quartz*. I have recently found this in several places, from Woodbridge, near New-Haven, to Bellows-Falls in New-Hampshire, a distance of one hundred and fifty miles, in loose rolled masses. In the vicinity of Conway it is very abundant, and occurs crystallized in the common six-sided prisms; which are sometimes so flattened as to be three times as broad as thick. In Conway it occurs in veins in mica slate and granite; less fetid, however, than that which is found loose on the surface. It is traversed by thin seams, or veins, apparently ferruginous; its color is nearly milk white and its lustre a little resinous. In some specimens the fetid odour is very strong.

19. *Chalcedony.*

1. *Common Chalcedony.* At East-Haven, in greenstone. (*Silliman.*) Also in the same rock at Southington, Farmington, Hadley, Sunderland, Deerfield, Greenfield, Gill, and indeed, in almost every greenstone hillock and ridge from New-Haven to Gill. Its color is light grey, deep grey, brownish, yellowish and greenish grey; it occurs botryoidal, mammillary, cylindrical and reniform, and is often of a cloudy or milky appearance, and frequently, strongly translucent.

2. *Cacholong.* In greenstone, Deerfield. It is associated with common chalcedony, and frequently, envelopes it, or constitutes some of the bands of agates. Its color is milk or yellowish white.

3. *Carnelian.* In greenstone, Deerfield. United with common chalcedony and cacholong, into which it passes. Its color is usually pale or yellowish red. It is not abundant. Also at East-Haven.

4. *Sardonyx?* Some specimens of the carnelian in Deerfield greenstone, being reddish yellow and orange, appear to belong to this variety; but it occurs in so small quantities as hardly to be worth noticing.

Agate. This occurs at East-Haven and Deerfield; and as it is composed of varieties of chalcedony and quartz, this seems to be the proper place to notice it. A description of a part of the agates occurring in these localities has already been given with sufficient minuteness in the American Journal of Science, and in Cleaveland's Mineralogy. But since the publication of those accounts, Dr. Dennis Cooley has discovered a new locality in the Deerfield greenstone, from which he has obtained specimens so much superior to those heretofore found that they deserve a particular notice. The following is a description of specimens in his possession.

No. 1. Longer diameter of the face of the agate, nine inches—shorter diameter, six inches. Outer zone, greenish chalcedony, half an inch broad. Second zone chalcedony.

a little tinged with red, a quarter of an inch broad. The centre is occupied by an amethystine geode of a light purple. Weight of the whole agate, twenty-three pounds.

No. 2. Face seven inches by four—Outer band, one fourth of an inch wide, of yellowish red carnelian; second band greyish white chalcedony, one fourth of an inch. The remainder of the space is occupied by a geode of limpid quartz. The outer coat of carnelian is broken off from a large part of this specimen, leaving bare the whitish chalcedony, and it has a strong resemblance to the human cranium; exhibiting similar protuberances and concavities.

No. 3. Face three inches in diameter—outer band of yellowish red carnelian—second do. chalcedony a little tinged with red, one tenth of an inch—third do. chalcedony, one tenth of an inch—fourth do. light carnelian, one tenth of an inch. The centre is occupied by common quartz, not forming a geode.

No. 4. As it appears at one end: Diameter of the face three inches—outer zone three fourths of an inch thick, of yellowish green chalcedony—second do. carnelian, one fourth of an inch—third do. quartz, having a greasy aspect—fourth do. dark grey translucent chalcedony, a mere line in thickness—fifth do. quartz or milk colored chalcedony, one tenth of an inch—sixth do. dark grey chalcedony, a line broad—seventh do. quartz, one fiftieth of an inch—eight do. dark grey chalcedony, a line broad—ninth do. quartz, one tenth of an inch—tenth do. chalcedony, a line broad—eleventh do. quartz, one fiftieth of an inch—twelfth do. a line of chalcedony—thirteenth do. quartz, one thirtieth of an inch—fourteenth do. a line of chalcedony. The centre is occupied by limpid quartz. This is a *fortification agate*, and the parallelism of the several bands is most exactly preserved, and the angles are perfect. Viewed on a face at right angles to that above described, this specimen exhibits a *striped or ribband agate*.

No. 5. Made up of an almost countless number of darker and lighter colored bands of white and grey chalcedony—two or three small agates appearing on the same face.

This appears to be a real *chalcedonyx*; and such specimens are not uncommon.

No. 6. *Fortification and Eyed Agates*, in the same specimen. One of the latter is an inch in diameter, and has six or seven zones of lighter and darker chalcedony and one of carnelian, enveloping a nucleus of light blue chalcedony.

These specimens seem to want nothing but a polish to make them equal to any in the splendid cabinet in New-Haven. The rock in which they occur is not strictly amygdaloidal, but contains only a few large cavities; and so firmly are the agates fastened into their bed that one is often obliged to break them out by piecemeal; thus ruining the most superb specimens. The larger ones are not very abundant. The rock, however, has not been penetrated very far.

20. *Siliceous Sinter*. At East-Haddam, in gneiss and incrusting mica slate. (*T. D. Porter and Webster.*)

21. *Opal*. "Common opal has been found in Litchfield, though rarely." (*Brace.*)

22. *Flint*. Near New-Haven and in Woodbridge, in rolled masses. (*Silliman.*)

23. *Hornstone*. At Litchfield. (*Brace.*) At the Southampton lead mine; also in Conway. Also in greenstone at Southington and Deerfield. At the latter place it occurs in nodules often four or five inches in diameter. Its colors are grey, green, black with a tinge of red, and dark blue. Its fracture is sometimes a little conchoidal and glistening, sometimes dull and splintery; and it is scarcely translucent at the edges. Some specimens considerably resemble siliceous slate, and others appear like prase. But Professors Silliman and Dewey (the latter of whom has examined it chemically,) agree in calling it hornstone. Also in Sunderland in greenstone, in narrow veins—well characterised.

24. *Jasper*. Near New-Haven in rolled masses. (*Gibbs.*) Also at Cummington on the banks of Westfield river. (*J. Porter.*) Also on the banks of Deerfield river in Deerfield,

and in Conway, Leyden, &c. in rolled fragments, red, black and yellow.

25. *Corundum*. At Litchfield, massive and in six-sided prisms, imbedded in massive sappar. (*Brace*.)

26. *Cyanite*. At Litchfield, Harwinton, Watertown and near New-Haven. (*Silliman*.) At the former place a mass of this mineral, associated with talc, sulphuret of iron and corundum, is supposed to weigh one thousand five hundred pounds. (*Brace*.) Also at Middle-Haddam. (*Eaton*.) Also at Chesterfield, Mass. in loose masses in mica slate; where its bladed or imperfect prisms are two feet long. (*Hunt*.) Also at Granville. (*Dewey*.) Also at Plainfield. (*J. Porter*.) Also at Grafton, Vermont, and Charlestown, New-Hampshire. (*Hall*.) Also at Bellows Falls. (*Silliman*.) Also at Deerfield, in mica slate. (*Williams*.)

27. *Staurotide*. At Bolton, East-Hartford, Beacon-Hill, Litchfield, Harwinton and Chatham. (*Silliman, Brace, Eaton and Woodbridge*.) Also at Cummington. (*J. Porter*.) Also at Bellows Falls. (*Hall*.) The range of mica slate in which this mineral is found in Bolton, Chatham, &c. extends, with little interruption, into New-Hampshire and Vermont, at least as far as Bellows Falls; and its aspect is very similar throughout, and scarcely a mile of the distance is it wanting in staurotide; or rather, wherever I have crossed it, (in perhaps fifty places,) this mineral occurs; as in Vernon, where it is in vast quantities, in North-Wilbraham, Ludlow, Shutesbury, Leverett, Northford, Hinsdale, Chesterfield, Putney, Westminster, &c. In Chesterfield, New-Hampshire, Dr. J. A. Allen found crystals an inch and one fourth in diameter, and two inches and an half long, in the valley south-west of the meeting-house. A range of similar mica slate extends through Chesterfield, Mass. into Cummington, Plainfield, Hawley, &c. and here also staurotide occurs in abundance. In Chesterfield I noticed a mica slate rock, two or three feet thick, containing seven or eight distinct layers of this mineral.

28. *Pinite*. At Haddam, in mica slate and granite. (*Silliman and Webster*.) Also at Bellows Falls. (*Hall*.)

29. *Chrysoberyl*. At Haddam, on both sides of the river, in six-sided prisms and six-sided tables, in granite. (*Gibbs*.)

30. *Zircon*. At Sharon, Litchfield county, in quartz. (*Silliman*.) Also at Brimfield, in gneiss. (*Eaton*.)

31. *Siliceous Slate*.

1. *Basanite*. Sometimes found in alluvial soil on the banks of Deerfield river; but perhaps brought thither by the aborigines, who made use of this and of jasper for barbs to their arrows and pikes.

32. *Pitchstone*. Near New-Haven. (*Silliman*.)

33. *Mica*.

1. *Laminated*. At Leverett, Alstead, &c.

2. *Lamellar*. At Woodbury it is violet. (*Silliman*.) Also at Goshen, Mass. yellowish green and violet, and sometimes in rhombic tables. (*Gibbs*.) Of the same colors at Bellows Falls, in granitic veins. (*Silliman*.) Most of the mica in the granitic veins in Conway, Ashfield, Williamsburgh, Chesterfield, &c. is straw yellow, sometimes rose-red, and in these veins it exists in excess. It occurs in these and other towns also, in granite of a smoky or nearly black color.

3. *Prismatic Mica*. Near Watertown. (*Silliman*.) At Litchfield. (*Brace*.)

34. *Shorl*.

1. *Common Shorl*. At Haddam, in six-sided prisms, terminated by three-sided pyramids. (*Gibbs and Webster*.) It occurs in almost every town in the primitive region along the Connecticut. Localities where it is found abundant, or beautiful, are Pelham, Shutesbury, Orange and Brattleborough. At the latter place it is found abundantly near the centre of the town in mica slate or hornblende slate; and also near the north line of the town (mentioned in Cleaveland's Mineralogy as occurring in Dummerston.) it

exists in crystals half an inch in diameter and often four or five inches long, sometimes terminated by three-sided pyramids, in common white quartz. The contrast renders the specimens quite beautiful, and one large loose mass lies on the surface nearly two feet in diameter, which would be an ornament to a mineral cabinet.

2. *Green Tourmaline*. At Chesterfield and Goshen, Mass. (Gibbs.) These interesting localities have been so well described by Col. Gibbs, as to render any farther remarks unnecessary. (Am. Jour. Vol. I. p. 346.)

3. *Indicolite*. At Chesterfield and Goshen. (Gibbs.) At Bellows Falls. (Silliman.) At Hinsdale, New-Hampshire, in granite, in great abundance. (J. A. Allen.) This locality is found most readily by taking the road from Hinsdale to Winchester.

35. *Rubellite*. At Chesterfield and Goshen, Mass. (Gibbs.) See his account in the Journal of Science, as above cited.

36. *Feldspar*.

1. *Common Feldspar*. Near Haddam, greenish and translucent. (McEwen.) In the same vicinity it is of a light flesh color, and in large masses in granitic veins and beds. Also of the same color in pudding-stone, Deerfield. Also in large, bluish, imperfect crystals, in granite, Leverett. It occurs, of course, abundantly in all that part of the map colored as granite, gneiss and sienite.

2. *Adularia*. At Haddam. (T. D. Porter.) At West-Springfield and Southampton lead mine. (Waterhouse.) At Brimfield. (Eaton.)

3. *Siliceous Feldspar*. (Gibbs.) At Chesterfield, Mass. and Haddam. (Gibbs.) Also at Goshen—a new variety, discovered by Dr. Hunt.

37. *Precious Emerald*. At Haddam? For a discussion of the subject whether this mineral exists in the United States, see Cleaveland's Mineralogy, Vol. 1. p. 341.

38. *Beryl*. At Brookfield, Huntington and Haddam. (*Silliman*.) Also at Litchfield. (*Brace*.) Also at Chatham. (*Mather*.) Also at Chesterfield, Mass. and Goshen. (*Gibbs*.) At Chesterfield and Haddam the crystals are sometimes from nine to twelve inches in diameter. At Goshen some are rose-colored. I found some crystals of beryl four or five miles north of the centre of Haddam.

39. *Garnet*. At Haddam—four inches diameter. (*Silliman*.) Also at Tolland, nearly rose-red. (*Webster*.) Also at the cobalt mine, Chatham, in mica slate, crystallized in rhombic dodecaedrons, or rather six-sided prisms terminated by three sided pyramids—the prisms often considerably elongated—color pale red—size that of a common musket bullet. Also at Plainfield, in limpid quartz, in trapezoedrons, or having at least as many as twenty-four sides—color of the mass nearly iron black. Found by J. Porter. Also at the same place in talco-micaceous slate, in dodecaedrons; color brownish red; size of a pea. Also at the same place, in dodecaedrons, truncated and striated on all their edges by hexaedral faces; presenting thirty-six faces in the whole—color dull red—size of a common bullet. Also at the same place in talcose slate, in dodecaedrons of the same color, sometimes two inches in diameter. Also at Chesterfield, Mass. with sappar, in trapezoedrons; color light rose-red—size of a pea. Also in hornblende and mica-slate, in Conway and Deerfield; color nearly black—crystals dodecaedrons—sometimes as large as a common bullet. Also in Conway, a loose mass, almost wholly made up of small black garnets in dodecaedrons—size less than one tenth of an inch in diameter, and with scarcely any difference in the size of hundreds. Also at Marlborough, Vermont, one mile south of the meeting-house, in dodecaedrons of a cherry-red, in chlorite slate; but hardly the precious garnet. They occur at this spot in immense quantities, and beautiful specimens may easily be obtained. A hundred other localities of the common garnet might be mentioned; since it occurs in all our primitive rocks: but the most interesting have been noticed.

1. *Pyrope*. At Brimfield, Mass. in granite, the feldspar of which is light green—in rounded irregular masses of a del-

icate poppy red, much resembling some varieties of the ruby. "It scratches crystallized quartz," says Professor Dewey, "and melts, rather hardly, into a dark enamel." Found in digging a well.

2. *Colophonite*. At Conway?

40. *Magnesian Garnet*. At Haddam. (Vide Cleaveland's Min. Vol. 2. p. 777.)

41. *Epidote*. At Milford Hills, in primitive greenstone. (Silliman.) Also at Litchfield and Washington, in graphic granite and sienite; crystallized. (Brace.) Also at Haddam, crystallized. Also at Tolland. (Webster.) Also at Athol, Worcester county, Mass. in prismatic bladed crystals, associated with black radiated schorl and hornblende. Also in Shutesbury, in small crystals in gneiss. It occurs also in a great many other places, disseminated in various rocks, and not very interesting.

1. *Zoisite*. At Haddam. (Webster.) Also at Wardsborough, Vermont, in much compressed, greenish grey, prismatic crystals; sometimes a foot long and one or two inches wide. (Dewey.) Discovered by Dr. J. A. Allen. Also at Leyden, Brattleborough and Westmoreland. (Hall.)

2. *Arenaceous Epidote*. At Haddam. (Webster.) Also at Shutesbury, Leyden, Shelburne, Buckland, Whately, Belchertown, Monson, and a great number of places, in hornblende and greenstone slate.

42. *Prehnite*. Near New-Haven, in secondary greenstone, in radiated masses, or in veins. Also at Woodbury, in the same sort of rock, in mammillary, botryoidal and almost globular masses. (Silliman.) Also between Simsbury and Wintonbury, in mammillary masses in greenstone. (Hayden.) Also in Deerfield, Greenfield, and, indeed, in almost every part of the secondary greenstone ranges from New-Haven to Gill; in all the forms mentioned above. In Deerfield the radiated masses sometimes contain pyritous copper. They occur there, also, on pseudomorphous quartz, having evidently been formed since the decomposition of the crystals originally occupying the cavities. In the same

place, I have found prehnite crystallized in groups on chalcedony; but could not determine the form of the crystal. Also near Bellows Falls in primitive rocks. I saw specimens in the cabinet of Dr. Wells; but was not informed of the precise locality: yet the mica attached to the specimens indicated their detachment from the older classes of rocks.

43. *Stilbite*. At Woodbury, well characterized. (*Silliman*.) Also at Deerfield in secondary greenstone; usually associated with chabasie. Its crystals appear to be right prisms, whose bases are rhombs with angles of about 60° and 120° . They rarely exceed one tenth of an inch in their longest direction. They are frequently grouped so as to become mere foliated masses. The lustre of the folia is pearly, and they are usually a little curved; color white. On hot coals it whitens and before the blow-pipe intumesces and melts into a white spongy enamel. It is but rarely met with.

44. *Zcolite*. Near New-Haven it is found in secondary greenstone, crystallized, or radiated, or mealy. (*Silliman*.) Also at Deerfield, in radiated fibrous masses, sometimes as large as a musket bullet, or more rarely an inch in diameter.

45. *Laumonite*. In secondary greenstone, also in loose rolled masses of pudding-stone near New-Haven. (*Silliman*.)

46. *Analcime*. At East-Haven, with chalcedony and agates. (*T. D. Porter*.) Also at Meriden, Connecticut. (*Silliman*.) Also at Deerfield, usually in laminated or radiated masses, which are reniform, cylindrical and nearly spherical. Very rarely in trapezoidal crystals—color white, grey and flesh-colored. Associated with calcareous spar, quartz, chalcedony, &c. and frequently effervesces a little with the acids.

47. *Chabasie*. At Deerfield, in cavities and seams in secondary greenstone; usually crystallized in transparent, or brownish, or yellowish crystals; presenting the primitive form, from one twentieth to one fourth of an inch in diameter, insulated and grouped on limpid, pseudomorphous and

tabular quartz, chalcedony, balls of zeolite, &c. Hundreds of specimens have been obtained at this place. To procure them, however, requires much labour.

48. *Apophyllite*. Near Saybrook, Connecticut. (Gibbs.)

49. *Tremolite*. At Milford, Washington, Goshen, Canaan, (Conn.) &c. in dolomite and granular limestone. (Silliman.)

A mineral is found at Leyden in great quantities, associated with quartz, limestone &c. and sometimes forming the gangue of the red oxid of titanium; the same occurs also at West Haven or Orange in hornblende—also at Leyden? at Colrain? at Shelburne? at Conway? at Goshen? (Mass.) at Guilford? and Brattleborough? Vt. and in various instances, in vast abundance: this mineral has generally been called *tremolite*, and sometimes *zoisite*, but it is probably *scapolite*.

50. *Asbestos*. At New-Haven and Milford, in serpentine, very beautiful. (Silliman.) Also at Pelham, Mass. where it occurs with serpentine and talc.

Amianthus. At New-Haven and Milford. Also at Washington. (Silliman.)

51. *Augite*. At Litchfield in dolomite—the whitish variety. (Brace.) Also at Brookfield and Washington in dolomite. (Eaton.) Also at Goshen, Mass. in granite, in flattened greenish gray prisms, sometimes eight inches long and two inches wide. This locality is one mile north of the meeting house, on the road to Ashfield. Also at Deerfield, in secondary greenstone, associated with quartz and calcareous spar, either in irregular veins or imperfect crystals—colour black—not abundant.

1. *Sahlite*. Near New-Haven in serpentine rocks belonging to the formation of verd-antique marble. (Silliman.)

52. *Common Hornblende*. This, of course, occurs in great quantities as a constituent of several rocks marked on the map; indeed, it may be found in a good degree of purity almost every where along the Connecticut, either in place or in rolled masses.

1. *Lamellar Hornblende*. Good specimens are found in Holland Mass. (Eaton.) Also in Leverett, Sunderland, Conway, &c. of a black colour, in Shutesbury it is green. It is found in sienitic granite and gneiss, in scales that are easily mistaken for black mica.

2. *Fibrous Hornblende*. At Leyden, the fibres very fine. Also near Bellows Falls. extremely beautiful, associated with quartz. Also in Shelburne, Conway, Goshen, &c. in mica slate, in large and broad fibres or lamellae.

3. *Fasciculite*. This is composed of fibres, or rather in many instances, of lamellae, frequently more than $\frac{1}{8}$ of an inch broad, diverging at both ends, so as to occupy usually, as many as 60° of a circle. These lamellae are commonly inserted perpendicularly to the folia of the slate in which they occur, and are applied to each other by their broader faces, being bent outwards on both sides, somewhat like a bow, and presenting elegant and very perfect fascicles. The fibres or lamellae, scarcely, if ever, cross one another; yet sometimes they diverge in nearly straight lines, and sometimes are so much curved as to resemble very exactly a sheaf of grain when standing erect. (See Plate 9.) The figure in the plate does not give a representation more regular or distinct than many of the most perfect specimens present. The length of the fibres or lamellae varies from one to four inches. It is found in mica slate and talco-micaceous slate in Hawley, Plainfield, and Conway. Probably this variety is comprehended under *Fibrous Hornblende* by Cleaveland; and perhaps specimens as perfect as those described above are not unfrequent. But so exact and striking an instance do these exhibit of the fascicular structure of minerals, that I could not resist the temptation to denominate them *Fasciculite*.

4. *Hornblende Slate*. For an account of this, see the Geological part of this sketch.

53 *Actynolite*. At Saybrook, and near N. Haven in serpentine. (Silliman.) Also at Litchfield. (Brace.) Also at Middlefield. (Dewey.) Also at Hawley. (Eaton.) Also at Cummington. (J. Porter.) Also at Windham in compressed

four sided prisms, in steatite and talc; the specimens superb. (Hall.) Also at Chatham Ct. near the bank of the river opposite the upper ferry in Haddam, in an enormous granitic vein; associated with black schorl, magnetic oxide of iron, &c. Also at Belchertown. Also at Shutesbury in gneiss. Also at New Salem in acicular crystals in chlorite. Also at New Fane, where it was discovered by Dr. J. A. Allen. It occurs in steatite in four sided, sometimes very perfect, sometimes flattened and striated crystals, five or six inches long, often half an inch broad, generally radiated, sometimes curved and crossing one another. The colour is a dark beautiful green, and the specimens are very elegant.

54. *Anthophyllite*. It is said to have been found near Saybrook (Cleaveland's Mineralogy.)

55. *Diallage*. In serpentine rocks near New-Haven—well characterised. (Hall.) Also in Conway? in granite.

56. *Macle*. At Bellows Falls, Croyden, Cornish, Charles town, Langdon and Alstead in argillite. (Hall.) According to Mr. Nuttall, the foliated mineral occurring so abundantly in the mica slate in Chesterfield, Plainfield, Hawley, Heath, &c. being usually inserted in small bronze coloured plates, nearly at right angles with the folia of the slate, may be macle.

57. *Serpentine*.

1. *Precious Serpentine*. At Milford, in nodules or irregular masses in primitive limestone. (Silliman.)

2. *Common Serpentine*. In extensive beds and variously blended with limestone at Milford and New-Haven, forming the Verd Antique. (Silliman.) Also at Westfield in granite. (Eaton.) Also at Middlefield, associated with steatite. (Dewey.) Also at Grafton, Windham and Putney, Vermont, in large insulated masses weighing many tons. (J. A. Allen.) Also at Pelham Mass. in a large loose mass penetrated by asbestos and associated with talc. Also at Leyden, Shelburne, Deerfield, &c. in small rolled masses.

58. *Talc*.

1. *Common Talc.* At Haddam, Litchfield and Southampton. (Cleaveland) Also at Cummington in steatite. (J. Porter.) Also at Middlefield in steatite. (Dewey.) Also at Windham in steatite—laminæ very large and beautiful. (Hall.) Also in New Fane in steatite—specimens laminated and elegant. (J. A. Allen.) Also at Pelham, associated with serpentine and asbestos. Also at Rowe.

2. *Indurated Talc.* At Milford marble quarry. (Silliman.)

3. *Scaly Talc.* At Windham and New Fane. (J. A. Allen.)

59. *Steatite.*

1. *Common Steatite.* Near New-Haven and at Litchfield. (Cleaveland.) Also at Middlefield connected, with serpentine and mica slate, and crystallized in six sided prisms terminated by six sided pyramids. (Dewey.) Also at Grafton and Windham. (Hall.) Also at New Fane and Marlborough. (J. A. Allen.) Also at Savoy and Cummington (J. Porter.) Also at Westminster, Vermont, where, as well as at Grafton, it is wrought into aqueducts and answers a valuable purpose. Also at New Salem forming a bed in gneiss.

2. *Potstone.* At Grafton, Vermont, in large quantities. (Hall.)

60. *Chlorite.*

1. *Common Chlorite.* Near New-Haven, penetrating quartz and calcareous spar, and in greenstone. (Silliman.) Also at Saybrook, crystallized. (T. D. Porter.) Also at Wardsborough, Vermont, in dark green folia. (Dewey.) Also at Halifax, Leyden, Conway, &c. foliated. Also at Miller's Falls in Montague penetrating milk white quartz. Also at New Salem. Also in greenstone amygdaloid at Deerfield, Greenfield, Gill, &c. It fills two thirds of the cavities in some varieties of greenstone, and to the naked eye has a radiated aspect, but Professor Dewey remarks,

that it does not appear to be radiated under a magnifier, great or small; but to consist of folia curiously arranged often with no regularity and their length somewhat greater than their breadth."

2. *Chlorite Slate*. For an account of this, see the map and the Geological part of this sketch.

3. *Green Earth*. A part of the chlorite described above in the amygdaloid in Deerfield, &c. appears to belong to this variety.

61. *Argillaceous Slate*.

1. *Argillite*.

2. *Shale*.

3. *Bituminous Shale*. For a description of these minerals the reader is referred to the Geological part of this sketch.

62. *Claystone*. This is found in rolled peices in the bed of Connecticut river below where it cuts through the coal formation at Gill; and probably this mineral is worn from thence by the water. The pieces frequently occur in the form of a prolate spheroid, sometimes flattened, even to the shape of a wheel, and sometimes assuming shapes bearing a resemblance to the sculptured images of Petsia and India. It is opaque—colour, light gray—scarcely adheres to the tongue, and yields a slight argillaceous odour—fracture dull and uneven, a little conchoidal—easily scratched with a knife and even by the finger nail; yet its particles scratch iron. It does not effervesce with acids.

63. *Clay*.

1. *Porcelain Clay*. At Washington Ct. in small quantities. (Cleaveland.) Also at Plainfield. (Silliman.) Also at Conway and Leyden in small quantities.

2. *Potters Clay*. In the older alluvion along the Connecticut, abundant.

3. *Loam*. In the newest alluvion along the Connecticut.

4. *Fuller's Earth*. At the bed of iron ore in Kent. (Silliman.)

64. *Sulphur*. This occurs pulverulent in small quantities in mica slate, in Warwick, Shelburne, Conway, &c. Perhaps it proceeds from the decomposition of some sulphuret.

65. *Graphite*. At Cornwall, Connecticut. (Brace.) Also at Tolland. (Webster.) Also at Hebron and Sharon. (Cleaveland.) Also between Sturbridge and Holland, Mass.

66. *Coal*. At Durham, Middletown, Chatham, Southington, Berlin, Suffield, Enfield, Somers, Ellington and South Hadley. (Silliman.) Also in the drift of the Southampton lead mine. From some of these localities, the coal is highly bituminous, in others scarcely so at all.

67. *Lignite*.

1. *Jet*. At South Hadley. (Gibbs.)

68. *Peat*. In small quantities at Leverett, Mass.

69. *Native Silver*. At Huntington in the bismuth mine. Also at West River Mountain, Chesterfield, New-Hampshire. (Silliman.) After the remarks and explanations given by Prof. Silliman. (Am. Journ. Sci. Vol. III. p. 74. note,) no reasonable doubt can remain concerning this last locality.

70. *Sulphuret of Silver*. In Connecticut it is said to have been found. (Cleaveland's Mineralogy.)

71. *Native Copper*. At Bristol, Connecticut, in a vein with the red oxide of copper. (Gibbs.) Also on the Hamden hills, a mass of about ninety pounds, adhering to the rock. Also twelve miles from New-Haven near the Hartford turnpike, a mass of six pounds in alluvial soil. (Silliman.) Also at Whately, Mass. in geest, on the limit between the primitive and alluvial soil, and about five miles

from secondary greenstone or the coal formation. The piece weighs seventeen ounces and very much resembles the last mass above described, exhibiting imperfect rudiments of octaedral crystals on the surface, and being encrusted by green carbonate of copper. The cavities also contain a very little red oxide of copper.

72. *Sulphuret of Copper*. Near New-Haven, at Simsbury mine, &c. (Silliman.)

73. *Pyritous Copper*. At Cheshire, Simsbury, &c. (Silliman.) Also at the Southampton lead mine, where it occurs amorphous and crystallized in regular tetraedrons which are insulated on calcareous spar. For the specimens containing these crystals, I am indebted to Dr. David Hunt. Also at the Leverett lead mine amorphous. Also in greenstone, Deerfield. Also at Greenfield in veins, in greenstone and sandstone.

74. *Variegated Pyritous Copper*. This occurs sparingly disseminated in calcareous spar in sandstone of the coal formation. In the island in the middle of Connecticut river at the falls in Gill. I am indebted to Prof. Dewey for the determination of this mineral.

75. *Antimonial Gray Copper*. Near Hartford, in the red sandstone formation. (coal formation?) (Maclure.)

76. *White Copper*. At Fairfield?* Connecticut. (Silliman.)

77. *Red Oxide of Copper*. At Bristol, in a vein with native copper. (Gibbs.) Also with native copper in the greenstone mountains extending northerly from New-Haven. (Silliman.)

78. *Green Carbonate of Copper*. At Greenfield, near the Falls in Gill, in two veins with pyritous copper, in considerable abundance near the surface. It is amorphous and even earthy.

* There is great reason to believe that this locality is not correct.—Editor.

1. *Fibrous Malachite*. At Cheshire, &c. in small but good specimens. (Silliman.)

79. *Arsenical Iron ? or Arsenical Sulphuret of Iron ?* At Gill in a loose mass weighing several pounds. Found by Dr. Alpheus Stone.

80. *Sulphuret of Iron*. (Pyrites—Iron Pyrites.) This is found in every town and in almost every rock along the Connecticut; as in the bituminous shale at Westfield and Sunderland, compact and amorphous; also in other rocks of the coal formation. Also at Plainfield, disseminated in limpid quartz. Also at Hawley, compact and unmixed with any gangue. Also at Halifax, Vermont, in an immense mass found in digging a cellar. Also with micaceous oxide of iron at Montague. Also at the Southampton lead mine, beautifully crystallized in octaedrons which are truncated in all their angles. It is grouped or insulated on crystallized quartz, and the crystals are about as large as a small shot, yet perfectly distinct and well marked.

81. *Magnetic Sulphuret of Iron*. At Brookfield, abundant in granite. Also at Huntington with bismuth, &c. (Silliman.) Also near Woodbury in gneiss. (Eaton.)

82. *Arsenical Sulphuret of Iron*. At Derby Middletown, and the Chatham Cobalt mine. (Silliman.) Also at Leicester, Mass. in gneiss. (Dewey.)

83. *Magnetic Oxide of Iron*. At Somerset, Vermont, in beds from one inch to two feet thick, in mica slate. (J. A. Allen.) At Chatham, near the bank of the river, opposite the upper ferry in Haddam, in a granite vein with schorl, actynolite, garnets, &c. The crystals are octaedrons, well defined, and often nearly an inch in diameter. Also at Plainfield, Shelburne, Athol, Shutesbury, &c. in smaller octaedrons in mica slate and gneiss. Also in beds in talcose slate at Hawley. Also in beds in Bernardstown.

1. *Iron Sand*. At West Haven beach abundant. (Silliman.) Also on the beach near the Light House in East Haven in great abundance. Also a little below Turner's Falls in Gill, on the southeast bank of Connecticut river.

84. *Specular Oxide of Iron.* Sometimes covering quartz and other minerals; as at New Fane and Leyden; but not abundant.

85. *Micaceous Oxide of Iron.* At Jamaica, Vermont, in dolomite; very handsome. (*J. A. Allen.*) Also at Hawley and at Montague: for a description of which, see the general view of mineral veins and beds that precedes this list of minerals.

86. *Red Oxide of Iron.*

1. *Scaly Red Oxide of Iron.* At Kent, Connecticut. (*Gibbs.*)

2. *Red Hematite.* At Kent. (*Gibbs.*)

87. *Brown Oxide of Iron.*

1. *Brown Hematite.* At Salisbury and Kent, Connecticut. (*Silliman.*) Also at Westriver mountain in Chesterfield, New-Hampshire, in mica slate.

88. *Argillaceous Oxide of Iron.*

1. *Granular Argillaceous Oxid of Iron.* At Salisbury. (*Cleaveland.*)

2. *Nodular Argillaceous Oxide of Iron.* At Putney, Vermont, in beds of common clay. The masses are oval and elongated, embracing an earthy nucleus. Also near the falls in Gill, in a dark hard slate of the coal formation.

3. *Bog Ore.* At New Braintree, Massachusetts, where it is wrought—also at Greenfield.

89. *Carbonate of Iron,* (spathic iron.) At New-Milford, in abundance, (*Silliman.*)

90. *Sulphate of Iron.* Efflorescing on mica slate in small quantities in Conway, Hawley, &c.

91. *Chromate of Iron.* At New-Haven and Milford; dis-

seminated in the verd Antique marble. (*Silliman.*) Also at Middlefield in serpentine. (*Eaton.*) Also at Cummington, well characterized and almost exactly resembling the Baltimore chromate ; in a loose mass—Found by Dr. J. Porter.

92. *Sulphuret of Lead.* At Middletown, Southington, and Huntington, where it is uncommonly argentiferous, and at Bethlehem, (*Silliman.*) Also at Berlin, (*Percival.*) Also at Southampton, Montgomery, Hatfield, Leverett, where are two localities, and Whately. At these places the structure of the ore is commonly foliated, sometimes granular and sometimes in cubical crystals.

93. *Carbonate of Lead.* This exists in the cavities of the matrix of the lead mine at Southampton. Its colour is white or mixed with yellow. Before the blow pipe it decrepitated and readily yielded a globule of lead. It occurs crystalized as follows.—1. Two six sided pyramids united at their bases and deeply truncated at their apices—making fourteen faces to the crystal.—2. A six sided prism, terminated by four sided pyramids, two of the faces being enlarged—fourteen faces to the crystal.—3. Tabular prisms with bevelments on the edges ; but the precise form I could not determine. These tables frequently cross one another.

94. *Carbonated Muriate of Lead.* At the Southampton lead mine in light green groups of cubic crystals, terminated by tetraedral pyramids. (*Meade.*)

95. *Sulphate of Lead.* At Huntington with argentiferous galena. (*Silliman.*) Also at Southampton lead mine, in plates or tables on galena. (*Meade.*)

96. *Phosphate of Lead.* At Southampton lead mine, in light green spherical masses, having a radiated structure.

97. *Molybdate of Lead.* At Southampton lead mine in tabular, wax yellow crystals. (*Meade.*)

98. *Sulphuret of Zinc.* At Berlin. (*Silliman.*) Also at Southampton lead mine, foliated and crystalized. The

crystals are so grouped that it is difficult, in the specimens which I saw, to seize upon the precise form. I think, however, I found the octaedron with truncated pyramids. Also at Leverett, foliated.

99. *Arsenical Nickel*. At Chatham, associated with arsenical cobalt. (Pierce and Torrey.)

100. *Arsenical Cobalt*. At Chatham. (Silliman.)

101. *Arseniate of Cobalt*. At Chatham. (Pierce and Torrey.)

102. *Oxide of Manganese*. At Leverett, in alluvial soil forming a bed five or six inches thick a few inches below the surface. It is in rounded irregular masses from the size of a pea to an inch in diameter and considerably resembles granular oxide of Iron. Also at Deerfield; forming crusts on quartz and mica slate.

103. *Native Bismuth*. At Huntington. (Silliman.)

104. *Native Antimony*. At Harwinton, Litchfield county, in broad plates. (Silliman.)

105. *Sulphuret of Antimony*. At Harwinton.* (Silliman.) Also near South Hadley. (Gibbs.)

106. *Native Tellurium*. At Huntington, associated with tungsten, bismuth, silver, &c. (Silliman.)

107. *Sulphuret of Molybdena*. At Saybrook. (T. D. Porter.) Also at East-Haddam and Shutesbury. (Silliman.) Also at Brimfield. (Eaton.)

108. *Yellow Oxide of Tungsten*. A new species discovered, analyzed and described by Professor Silliman. At Huntington in a gangue of quartz.

109. *Calcareous Oxide of Tungsten*. At Huntington. (Silliman.)

110. *Ferruginous Oxide of Tungsten*. At Huntington. (Silliman.)

* 104 and 105 need confirmation.—Editor.

111. *Red Oxide of Titanium*. Near New-Haven—also at Oxford in large geniculated crystals in mica slate—also at Huntington, at the bismuth mine;—crystals as large as the thumb and geniculated. (Silliman.) Also at Litchfield, sometimes reticulated on mica slate. (Brace.) Also at Worthington, Massachusetts, in quartz. (Brace.) Also at Leyden, in four or eight sides, often handsomely geniculated, generally striated, crystals; in limpid quartz, tremolite and hornblende. Some of the specimens have several geniculations and are as large as the thumb. Hundreds of good specimens have been collected at this locality. Also at Brattleborough, Colrain, Shelburne, and Conway, in quartz, mica slate and tremolite. At Shelburne I found its crystals penetrating a vein of quartz in mica slate in place. In Conway a few small crystals have been observed exhibiting the primitive form and presenting the “kind of twin crystal,” described in Rees Cyclopaedia, Art. Rutile. This mineral, indeed, may be found in almost any spot between Conway and Brattleborough, on a strip several miles wide.

112. *Silico-Calcareous Oxide of Titanium*. At Brattleborough, near the north line of the town in a boulder of granite, which has flesh coloured feldspar—colour dark brown, or chesnut. Some of the crystals appear to be six sided prisms. (Dewey.) These prisms are terminated, if I mistake not by three sided pyramids. I also noticed a four sided, flattened and striated prism, whose terminations could not be determined.

113. *Ferruginous Oxide of Columbium*. At Haddam, in granite. (Berzelius and Torrey.)

Remark.—Since the above list of localities was completed the following have occurred; but as they cannot be conveniently inserted in their proper places they may be mentioned here.

Fibrous Limestone, Satin Spar, in bituminous shale—with Ichthyolites at Sunderland. *Andalusite*, at Litchfield, Delafield.

[To be concluded in the next Number.]

ART. II.—*Notice of the Alluvial District of New-Jersey, with remarks on the application of the rich marl of that region to agriculture.* By JAMES PIERCE, Esq.

The triangular peninsula situated in the southern part of New-Jersey is bordered on the south and east by Delaware Bay and the ocean, on the north by the Raritan, and west by the river Delaware. It is about one hundred and ten miles in length by eighty in breadth, and is entirely alluvial. South of the Nevesink hills it seldom rises sixty feet above the sea. These hills border Amboy Bay and the entrance of Shrewsbury creek for several miles, and extend with diminished height to the Delaware. They are elevated adjacent to the sea three hundred and ten feet above its level, and occupy ground where formerly the waves of the ocean rolled. They rest in some places on banks of oyster-shells and other marine relics, blended with clay and sea-mud. Above the calcareous beds is a layer of dark clay. A sandy earth highly colored by oxide of iron and imbedding reddish brown sand and pudding stone cemented by iron, composes the higher strata—large rocks and beds of ferruginous sandstone, apparently in place, of a more recent formation than the alluvial region below, and embracing sufficient metal to be called an ore of iron, are of frequent occurrence.

Particles of iron are blended with the sand of the beach. Some of the streams which descend from the top of the clay strata are red with oxide of iron.

Efflorescences of the sulphates of iron and alumine are often observed. Flame proceeding from the spontaneous combustion of gases probably generated in beds of sulphuret of iron, has been noticed on these mountains.

The strata of the steep eastern declivities are exhibited by frequent land slips. But a small portion of the eastern section of the Nevesink hills is under cultivation. They present a woody region, in which deer are sometimes sheltered. From the summit of these hills a view of the ocean is disclosed in grandeur unrivalled on our sea-board. The coast is presented to the north-east and south as far as vision can reach. The land prospect is extensive and interesting.

Sandy-Hook, situated east of the Nevesink hills, from which it is separated by a narrow bay, is six miles in length; in width it seldom exceeds half a mile. It was formerly an island, but the channel affording a direct water communication between the sea and Shrewsbury river, is now filled up. This peninsula exhibits an alternation of barren sand hillocks, plains and cedar thickets. The sand-banks are often laid low by sweeping tempests. The hillocks of Sandy-Hook and of our southern sea-board are many of them formed by the lodgment of sand around a cedar or other bush, increasing with the growth of the plant, and when the bush is no more the hill disappears. The beach and sandy elevations from a short distance resemble a snow covered surface.

There is no creek or inlet on the sea-shore from the light-house, which is situated on the northern extremity of Sandy-Hook, to Long-Branch, a distance of twelve miles. A walk or ride upon the hard beach at low tide is interesting, particularly by moon-light, when an extensive range of coast is seen, whitened by successive breakers—wrecks of vessels are visible at short intervals, melancholy monuments of the dangers of the sea.

For many miles no houses, enclosures or signs of human occupancy are in view. Long Branch is much resorted to for sea-bathing; its situation is good. The land adjacent to the ocean is at this place compact, and rises perpendicularly from the beach near twenty feet. Waves in a tempest often roll over this bank, making encroachments by their friction. The neighboring country is level, free from marshes, and under cultivation. The boarding-houses are situated about twenty rods from the water, leaving handsome lawns in the intermediate space. The high banks of the sea and of Shrewsbury river are formed by strata of sand, clay and sea-mud. The clay is in many places white with saline efflorescences, principally sulphate of alumine.

Much of the land situated in the northern part of the peninsula is under cultivation, and in some of the townships of Monmouth county, adjacent to Amboy Bay and the ocean, a considerable portion of the land is good, and has been rendered very productive by the application of marl. Six years since, but one or two small beds of this valuable manure were known in this region, and but few experiments of its utility had been made. The inhabitants, ignorant of its

character and value and of modes of examination, had passed rich beds without regard; marl is now extensively used and highly esteemed.

The marl district extends from the hills of Nevesink adjacent to the ocean, to the Delaware, and is in width about twelve miles. Marl has been discovered in numerous places of this tract. It is often noticed on the banks of streams and breaking out of hills of which it forms the nucleus, waving with the surface, and thus rendering access easy.

These beds, apparently inexhaustible, are in some places elevated near one hundred feet above the level of the sea. This marl is composed of sand, clay and calcareous earth, blended with shells and other marine organic remains, in different stages of decay. The shells, more or less entire, are not mineralized. Exposed on the surface they gradually decay, furnishing fresh manure for the soil.

I visited several beds of marl and found them of a pretty uniform character. The color is generally grey or greyish white, and good in proportion to its whiteness, which indicates the quantity of calcareous earth it contains. From thirty to eighty loads of marl, according to its strength, are spread upon an acre. It is believed that a good dressing will last from twelve to twenty years. The lands of Monmouth county are said to be enhanced in value more than half a million of dollars by the discovery and use of marl.

A respectable farmer of Middletown mentioned to me, that five years since he contemplated abandoning his large farm for land of other districts, as his own was unproductive. Learning the discovery of marl, he made himself acquainted with the modes of examining, and found good beds of this manure in almost every field, and liberally applied dressings to the soil. In walking over his grounds I observed rich white marl breaking out of banks and hillocks, and the streams paved with decaying marine shells. For more than a century this land had been regarded by the proprietors as useless.

The farm in its improved state exhibited a gratifying sight; the hills where formerly thorns, thistles and mullens disputed the dominion, now supported luxuriant corn. Extensive verdant meadows were clothed with a rank second crop of grass; numerous stacks of grain and well-filled barns evinced the productiveness of these fields, which are now estimated at three times the former value.

This marl is adapted for both sandy and clay earths. It was remarked to me by farmers of Monmouth county, that lands manured with marl are less affected by dry weather than other grounds. This doubtless arises from its rendering the soil a better medium to retain moisture. When there is too much clay, the numerous shells and fragments in the marl keep the soil loose and suffer water to penetrate—and if too sandy, the calcareous ingredients attract and retain moisture, while the clay of the marl improves the texture of the soil.

The rich marls found in Monmouth county adjacent to navigable rivers, might be advantageously transported to fertilize the sandy lands of the southern part of Long and Staten Islands.

Though marl is now employed in a comparatively small district of New-Jersey, it is probable from the character of the region, that it may be found throughout our alluvial seaboard, and would be very valuable where gypsum is powerless. Strata of marl have been passed through in sinking wells many miles south of Long-Branch, and also near the Delaware.

Shells and the bones of fish are often disclosed by excavations, made far from the ocean. Banks of oyster-shells covering extensive tracts and of unknown depth, have been observed in the interior of the southern States. It is from such calcareous ingredients that marl principally derives its virtue.

Organic remains of the land and sea have been found associated in the marl beds of New-Jersey, at a considerable elevation above the Atlantic. Among these are bones of the rhinoceros and other animals of the eastern continent, some of them of extinct species, elephants' teeth, deers' horns, bones of the whale, sharks' teeth and entire skeletons of fish, together with gryphites, belemnites, cardites and various shell-fish.

The origin of these banks of shells and bones may, I think, with propriety be ascribed to the deluge recorded in sacred history. The events which have since occurred within the observation of man can account for the various phenomena remarked in this alluvial district.

The interior of the peninsula is covered by extensive forests of pitch pine and shrub oak. Settlements are here and

there located in this region of wood. The soil, except on the borders of creeks, is pretty uniformly sandy.

Adjacent to the Delaware river and bay and the sea coast, there are wide tracts of salt meadow which are in a few places improved by embankments. The climate near the coast is so mild that herds of cattle subsist through the winter upon these meadows, and in the neighboring thickets, without expense to the proprietors. Cattle range the forest in a wild state. Deer, foxes and rabbits are numerous, and wolves and bears are sometimes seen in the wilds of New-Jersey. Much fine wood is shipped to Philadelphia and New-York from this region.

The peninsula, four fifths of which is now a useless waste, might by proper cultivation be rendered very productive. Its situation between the two largest cities of America, and nearly environed by navigable waters, would enable the inhabitants readily to bring their produce to a good market. A tract of a few miles in width from the sea-board might be improved by marl, sea-weed, fish, &c.; the remainder by gypsum, which is adapted for sandy soils. Pine lands, situated in the counties of Columbia, Albany and Saratoga, and other parts of the State of New-York of a similar character with those of New-Jersey, have been rendered very valuable by gypsum and rotations of crops, often producing from twenty to twenty-five bushels of wheat to the acre. The sandy soil is in time changed to a rich vegetable mould—gypsum would probably render the pine lands of the southern states productive.

The climate of New-Jersey is well adapted for grain, Indian corn, fruit and melons. Cotton might perhaps be there naturalized and profitably cultivated.

Herds of cattle and sheep can be supported at little expense. The sea coast is said to be favorable for the production of good mutton and wool.

The creeks and rivers of the peninsula are not numerous or considerable—they are generally bordered by a rich soil.

Salt may be advantageously manufactured on the islands and low Atlantic shore of New-Jersey, by evaporating seawater.

Extensive beds of the variety of argillaceous oxide of iron called bog-ore, are common in the south-western part

of the alluvial of New-Jersey, from which good iron for castings may be extracted. It is generally mixed with mountain ore in the furnace. The phosphate of iron is not unfrequently found imbedded in the bog-ore of New-Jersey. A valuable chalybeate spring, is situated in the town of Shrewsbury. White pipe-clay is abundant near Amboy Bay and the Delaware. The inhabitants of the New-Jersey sea-board generally subsist by a little farming, wood-cutting, fishing, and grazing of cattle on the salt-meadows.

ART. III.—*On the probable Origin of certain Salt Springs.*
By PROFESSOR AMOS EATON.

To the Editor.

Every fact which tends to disclose that hidden operation of nature by which the Salt Springs of the west are produced, is interesting to the geologist.*

I took a specimen of the rock called *water limestone* from a hill adjoining Nine-mile Creek, a few miles west of the Onondaga salt-springs. If this specimen be pulverized and examined ever so minutely, it presents nothing to the senses resembling common salt, (muriate of soda.) I do not mean that the elementary constituents cannot be found in it, but I do not propose here to have any reference to a chemical analysis of the rock. On exposing a fresh fracture of a specimen from this rock, for two or three weeks in a damp cellar, it shoots out crystals of common salt, sufficient to cover its whole surface. It may be proper to state, that I have made the trial only in very cold weather; during which time a fire was sometimes made in the cellar room. I do not know, however, that these circumstances had any influence on the result.

This proves conclusively, that one rock at least, reposing over the floor of the salt springs, contains in itself the

*This discovery, made in my first excursion on the canal route, in the employment of the Patroon of Albany, (the Hon. S. Van Rensselaer,) I take the liberty to communicate in his absence; because I know it is not his wish to withhold interesting subjects one moment from the public. As the extensive circulation of your Journal will bring this fact to the knowledge of scientific gentlemen in the vicinity of other salt-springs, it may induce satisfactory research.

materials for the spontaneous manufacture of salt. I say the *floor*, because I have ascertained that all the salt-springs along the canal route, from Lenox to Montezuma, are supported on the same continuous rock.

It has long been a prevailing theory, that a vast mine of salt exists in the vicinity of these springs, which is continually dissolving, and thus yields the supply of salt water. Much time and money have been spent without success, in boring to great depths with the expectation of discovering this mass of rock salt. But if such rocks as that of Nine-mile Creek, be found of sufficient extent, the origin of the salt waters of the west will find a more satisfactory solution. And there may be many kinds of rock, besides the water limestone, which contain the elementary constituents of common salt.

I am, respectfully,

Yours, &c.

AMOS EATON.

Troy, March 1, 1823.

REMARK.

The observation made by Mr. Eaton is very interesting; but (if we understand him correctly,) the *water-limestone* forms the *roof* of the salt-springs, or, at least, is so situated, that the water can percolate this stratum, by the natural effect of gravity. We can have no doubt, that this is Mr. Eaton's meaning, although there is some ambiguity in his language.

Editor.

ART. IV.—*On a Rocking Stone in Durham, New-Hampshire.* By JACOB B. MOORE.

Concord, N. H. Oct. 22, 1823.

TO PROFESSOR SILLIMAN.

SIR—Having noticed in the last number of the "American Journal of Science" an account of a Rocking Stone in Putnam county, New-York, in which mention is also made of the rock at Durham in this State,—I take the liberty to enclose you a description of that rock, which you may rely upon as accurate.

"In the town of Durham" says Dr. Morse, "is a rock computed to weigh sixty or seventy tons. It lies so exactly poised on another rock, as to be easily moved with one finger." Curiosities of this kind naturally excite attention, and from their rare occurrence, seem to merit a particular description; for were they the works of *art*, we should be surprised at the human ingenuity which could adjust the mighty balance; and as works of *nature*, they do not fail to excite our admiration. The rock at Durham is a detached block of coarse granite, of about fifteen feet in diameter on the top, and nearly round; and averaging about seven feet in thickness. It is situated on a rise of ground in the southerly part of the town, and in the neighborhood of a chain of granite ledges, which extend through the town and appear to be of primitive formation. The owner of this rock is a man nearly eighty years of age, who was born and always resided in the vicinity. At the age of twenty-four he came into possession of the farm upon which the rock is situated, and has since lived about fifty rods from it. He states, that formerly the wind would move the rock, and that its vibrations thus occasioned could be plainly seen at some distance. It was always easily moved with the hand, until some three or four years since, a party of gentlemen from Portsmouth visited it, and after several hours of labor, succeeded in moving it from its balance with levers. It was a barbarous curiosity, of which it is hoped the persons concerned are now ashamed! The rock cannot now be moved; although, in looking at it on the sides marked 1 and 2 in the following plan, a person would be led to think otherwise.

The left hand bottom figure (See the plate at the end,) represents the rock at Durham as it now lies, thrown to the right from its equipoise, and resting on two points. It also presents the side marked 3. The figures 1 and 2, present views of the sides thus marked, in the figure first mentioned. The figure 4 represents the surface of the rock, fifteen feet in diameter, nearly round. The weight of this stone probably approaches the estimate of Dr. Morse.

Besides this, I know of no rocks of a similar description, excepting one, weighing from fifteen to twenty tons, in Andover in this State, and one of smaller size in Ashburnham, Mass. Both these may be easily moved several inches by the hand; but their appearance is uninteresting, compared with the former situation of the rock at Durham.

ART. V *Miscellaneous Localities of Minerals, communicated by various persons.*

1. By Professor. J. F. DANA, of Hanover, N. H.

1 *Hornblende*. Superb specimens of crystallized hornblende, imbedded in lamellar hornblende, or confusedly aggregated—bladed and promiscuous, in quartz; Iron mines, Franconia, N. H.

2. *Garnet*. Amorphous and imperfectly crystallized—the faces of the crystals remarkably smooth and perfect; Franconia mine.

3. *Epidote*. Crystallized; same place.

4. *Green quartz*. Containing hornblende—colored by epidote. These are beautiful specimens. Franconia.

5. *Asbestos*. This mineral has a peculiar appearance. It occurs in masses or rather sheets of one or two inches thick, and of various extent. The fibres are intimately united, and are curved in every direction. Franconia.

6. *Staurolite*. Franconia. *Sulphuret of Copper*. Franconia.

7. *Cyanite*. Of a light bluish grey. Hartford, Vt.

8. *Sulphuret of Iron*. Deeply truncated on the angles of the cube, forming a solid of fourteen sides. Hartford, Vt.

9. *Galena*. In a vein of quartz traversing mica slate. Lebanon, N. H.

10. *Granular Argillaceous Oxide of Iron*. Sharon, Vt.

11. *Carbonate of Iron*. In rolled masses of quartz, on the banks of the Connecticut. Hanover, N. H.

12. *Plumbago or Graphite*. Large specimens—equal to the Borrowdale. Bristol, N. H. This has just been discovered—it is abundant; five hundred pounds were sent to Boston as a sample, as the owner informs me.

At the Franconia iron mine, near the furnace, I noticed a peculiar slag, which resembles perfectly some varieties of pumice-stone.

2. By Mr. STEUBEN TAYLOR, Preceptor of the Charlesfield Street Academy, at Providence.

1. *Quartz Crystals* are found pure and well defined, from one to two inches in length and from one third to three

fourths of an inch in diameter, in the western part of Granby, in a field a few rods north east of a blacksmith's shop, occupied by Mr. Tracy Cannon. In some of the rocks they form geodes of considerable size. Of these I obtained some specimens which, when placed near the blaze of a candle, exhibit a remarkably brilliant and beautiful appearance.

2. *Black Tourmaline*. Of this mineral there is a remarkable locality in Barkhamstead, on the farm of William Taylor, Esq. The rock in which it is found is a fine-grained granite, penetrated by a vein of quartz nine or ten inches wide. From this vein elegant specimens may easily be obtained by means of a hammer or sledge. I succeeded in getting one crystal, which is more than an inch in diameter and five inches long. The rock is situated about fifty rods W. N. W. of Mr. Taylor's house, and about the same distance east of the turnpike road leading from Hartford to Albany.

3. *Garnets* of twenty-four sides, of the size of a musket-ball, are found in great abundance on what is called West-Hill, in the town of New-Hartford. The spot which I visited is on the farm of Mr. Silvester Seymour, about forty rods west of the house occupied by Mr. Michael Olmstead. The rocks and stones in which they occur are easily broken in pieces, and the visitor will be detained but a few minutes in obtaining as many specimens as he wants.

3. By Dr. JACOB PORTER.

1. *Calcareous Spar*, beautifully crystallized, at Chester. Emmons.

2. *Stalactites* and *Stalagmites*, at the cave lately discovered in Lanesborough. When this cave was discovered, it was filled with stalactites and stalagmites of the most fantastic appearance, some of which were shown at a house near the cave. The most curious have been removed by the visitors; I obtained, however, a plentiful supply of the less interesting ones. There are several turnings or windings in this cave. Breathing is free here and lamps burn perfectly well.*

*The other facts stated by Dr. Porter may be found at p. 41, Vol. IV. of this Journal.

3. *Black Fluat of Lime*, in Huron county, Ohio.

4. *Gibbsite*, of *Torrey*, on iron ore, at *Lenox*. *Emmons*.

5. *Limpid Quartz*, at *Newport*, N. Y. ninety-five miles north-west of *Albany*. The crystals are perfectly transparent, and terminated by pyramids at both extremities. The largest that I have been able to procure is about an inch long and about three fourths of an inch in diameter. These specimens, together with those from *Fairfield*, which exactly resemble them, are the most beautiful rock crystals that I have ever seen.

6. *Blue Quartz*, in amorphous masses, at *Cummington*, *Bridgewater*, *Pembroke* and *Marshfield*.

7. *Rose Quartz*, beautiful, and in considerable quantities, in a ledge at the east part of *Chesterfield*.

8. *Irised Quartz*, in large quantities, at *Chesterfield*. Its colors, which are generally red, yellow or orange, and very delicate, seem to arise from a thin coat of metallic oxid on the surface of the specimen, or in its fissures.

9. *Milky Quartz*, at *Abington*, the cavities frequently lined with crystals.

10. *Greasy Quartz*, at *Plainfield*.

11. *Arenaceous Quartz*, at *Plainfield* and *Cummington*, often in large masses. It is sometimes burnt and pulverised for sand.

12. *Stalactical Quartz*, at some falls in a brook in *Middlefield*. The crystals, which are small and have a slight tinge of red, are formed on serpentine, evidently in a manner similar to that of stalactites. The specimens are singularly beautiful. *Emmons*.

13. *Amethyst*, a single crystal of a delicate purple, discovered at *Abington*.

14. *Fetid Quartz*, at *Cummington*.

15. *Chalcedony*, at *Middlefield*. It is of a milky or reddish color, with blood-red spots. The cavities are lined with the most minute and beautiful crystals, which are sometimes blood-red, but generally white or bluish. *Emmons*.

16. *Opal*, at *Middlefield*. It is covered with small crystals, whose color is white, slightly tinged with blue or yellow. *Emmons*.

17. *Hornstone*, at *Middlefield*. *Emmons*.

18. *Jasper*, dark-colored and red, on the beach at Marshfield, many of the specimens beautiful.

19. *Agate*, at Chester. Emmons.

20. *Kyanite*, very dark-colored, in mica slate, at Chester and Chesterfield.

21. *Mica*, dark-colored, at Savoy. The layers separate surprisingly on being heated.

22. *Green Mica*, at Cummington and Plainfield.

23. *Black Mica*, associated with garnets, at Plainfield.

24. *Mica*, white and yellowish, abundant at Williamsburg.

25. *Chabasie*, in cuboidal crystals, at Chester. Emmons.

26. *Tremolite*, well characterised at Chesterfield.

Tremolite, in shining, radiated fibres, associated with white quartz and beautiful garnets, at Cummington. The rock in which these minerals are contained, has a strong smell of sulphur.

27. *Asbestos*, adhering to a large mass of actynolite, at Windsor, near the Cummington soapstone quarry.

28. *Hornblende*, at Hawley, Plainfield and the neighboring towns. Many of the specimens, particularly those from Hawley, present crystals resembling bundles of rods tied together near the middle, and thence diverging, which give them a very singular and beautiful appearance.

29. *Serpentine*, in loose masses, at Cummington and Plainfield. It takes a fine polish.

30. *Chlorite*, abundant and extremely beautiful, at Hawley and Plainfield.

31. *Graphite*, at Hinsdale.

32. *Sulphuret of Iron*, in small but beautiful crystals at Hawley.

33. *Micaceous Oxide of Iron*, beautiful and in large quantities, at the iron-mine in Hawley. When pulverised it makes a beautiful paper-sand. At a manufactory in Cummington it is enclosed in tin cylinders, and used for clock-weights.

34. *Brown Hematite*, bearing a striking resemblance to the Salisbury ore, at Richmond. Emmons.

35. *Chromate of Iron*, at the Cummington soap-stone quarry. Only a small mass has as yet been discovered.

36. *Plumbago*, at Cummington, Worthington and Chester.

These minerals may be seen in the collection of the writer. Specimens have also been presented to the cabinet of

Yale College, the Lyceum of Natural History, New-York, and the Troy Lyceum of Natural History.

Plainfield, November 1822.

REMARK by Dr. Porter.

Some of these localities are already known to the public, and are here cited again for the sake of conveying some additional information. For my knowledge of several of them, I am indebted to the gentlemen whose names are annexed.

4. By Mr. J. STUART, of Peacham, Vermont.

1. *Asbestos and Serpentine*. One piece of the latter was from the mountain in Kellyvale, and the other from the streets of Peacham, where it is stated to be very abundant.

Of the asbestos, one kind occurs in rolled pieces, which, when broken, are found to contain a substance in color and texture resembling the finest cotton. The other is discovered in crevices of the rocks of serpentine, and more resembles flax. The place from which they were obtained is in Kellyvale, about twenty miles from Canada. The adjoining country, like most of Vermont, is primitive. The stones are principally granite. Farther back in all directions, are almost Alpine mountains. Approaching the quarry from the south, it is level for some distance, until we arrive upon the top of a steep precipice, about two hundred feet high, at the foot of which there is a very small stream. All along the declivity are masses of serpentine, much of which is rolled to the bottom; and from appearances the same mineral extends to a great distance into the side of the precipice. The quantity of asbestos as well as serpentine, seems inexhaustible. But though the serpentine would make excellent chimney-pieces, &c. yet it will probably never be wrought, on account of the difficulty of transportation.

2. *Quartz*. Finely crystallized as usual in six-sided prisms. Lyndon, Vermont.

3. *Cyanite*, in small quantities, small garnets, and tourmaline, are found in Peacham and its vicinity.

5. By Dr. W. LANGSTAFF.

1. *Quartz*, and a green substance which appears to be augite or coccolite—found in gneiss near Cold-Spring landing.

2. *Coccolite*, in foliated limestone; same locality with the zircon.

3. Do. in quartz—same locality.

4. { Do. in mass—same locality with the zircon.
Augite, abundant in the the gneiss rocks at Cold-Spring Landing.
 { Do. containing sphene. Cold-Spring Landing, N. J.

5. *Scapolite*, containing Plumbago. Hamburg.

6. *Brucite*. Hamburg.

7. *Black Mica*, in augite. Cold-Spring.

6. BY J. P. BRACE.

In Southbury, the greenstone formation visible in Woodbury continues west of the meeting-house, between the Pompanaug creek and the Housatonic—extending six or seven miles in length, being composed of several ridges, in all about a mile in breadth. The minerals connected with this range are :—

1. *Chalcedony*, resembling that of Patterson, N. J. of a beautiful blue—covered frequently by botryoidal concretions of *cacholong*.

2. *Amethyst*. The crystals of this mineral are often quite regular, with both terminations visible, and the coloring matter more uniformly diffused than is common in the amethyst of Woodbury, New-Haven and Patterson. Some specimens which I saw in the cabinet of Dr. L. Smith were very beautiful.

3. *Common Opal*, of an inferior quality.

4. *Prehnite*, occasionally.

5. The *agates* of this range are in nodules, composed of layers of blue and white chalcedony. These layers are, principally, incrustations of a solid nucleus of quartz, and are often quite handsome.

6. *Agatized Wood*, in the south part of the town—found by Dr. Smith. It presents distinct branches, with their knots, bark and ligneous layers often visible, sometimes four

or five inches in diameter. It is principally hornstone; its cavities are lined with minute quartz crystals and layers of chalcedony. It is of a grey or black color—specific gravity 2.6.

7. *Fibrous Carbonate of Lime*, in bituminous limestone, exists here.

8. The *Rose Quartz* is south-west of the meeting-house about three miles, and is in great quantities. It requires blasting, however, to obtain good specimens.*

9. *Laminated Feldspar*, of a pearly white color, is found in Bethlem, resembling in external characters the *siliceous feldspar* of Chesterfield.

10. *Plumose Mica*, in Woodbury and Washington.

11. *Zeolite*, in reniform masses of minute fibres, and in fascicular groups of fibrous crystals—in a vein in mica slate. Litchfield.

12. *Fetid Quartz*, in Litchfield, well characterized—of a dark greyish blue, (the common color,) and of a pure white, (the last, I believe, an uncommon color for this variety.)

13. *Pinite*. Litchfield. Specific gravity 2.768—infusible—massive—imperfectly foliated—cross fracture uneven—color dark brownish green—fissures stained by iron—soft, easily scratched with a knife—powder unctuous—streak white. Spangles of a hexagonal or nearly circular form appear on the fracture when held to the light. Lustre of the cleavage, glistening—of the fracture, dull—adheres to the tongue.

Some imperfect crystals appeared on the surface of the mass—apparently six-sided prisms, truncated on all the angles, and, in consequence, having a cylindrical form. Associated with quartz, mica and oxide of iron.

REMARK.

The Editor's opinion being requested, respecting the last mentioned mineral, he has to add nothing more, than that he coincides in opinion with Mr. Brace, and that there is a great resemblance between the Litchfield pinite and that of Haddan.—*Ed.*

*Dr. L. Smith will supply, in exchange, any gentlemen with the Southbury minerals.

ART. VI.—*Notice of a curious Water-Fall, and of Excavations in the Rocks.* By Professor HALL.

To the Editor.

In proceeding from Middlebury to Woodstock, on the directest turnpike road, the traveller, soon after he passes the tavern on the summit of the Green Mountain, notices a small, rapid, pellucid streamlet, which accompanies him nearly the whole distance down the mountain. He constantly hears its music, as it murmurs along its rugged course, and admires the transparency of its waters. This is one of the branches of the *White* river. About three miles from the tavern he crosses a rivulet, a little above where it empties into the former stream. He advances a few rods farther, and meets another. It comes from the north, and is called by the mountaineers, the North Branch. A little more than a quarter of a mile from the turnpike, up this stream, is an object which merits the attention of the curious. I have recently, been in company with the Rev. Professor Keith of William and Mary College, Virginia, to examine it.

There is a road cut, but not much travelled, along the western side of the North Branch, at a small distance from the stream. From the road the water is seldom visible, being concealed by a thicket of evergreens, and, in some places, by the banks which intercept the view of it. Its noise may be distinctly heard.

The better to accomplish our object, we proceeded up this road nearly half a mile, which brought us to the head of a succession of the most singular and interesting *rapids* that I ever saw. Here the student of nature would stand astonished to see how great effects have been produced by an apparently trivial cause.

At the northern extremity of the rapids, the ledge over which the water passes, is a variety of common chlorite rock, of a very dark brownish green color, containing veins of milky and greasy quartz. I have never before seen chlorite in such large masses. The fracture in one direction is extremely uneven. It may be scratched easily with the finger-nail. It is composed of minute scales, which are some-

what unctuous. At numerous places in and near the stream, we saw chlorite slate in abundance. Along the lower part of the rapids, the rocks are chiefly mica-slate. These rocks, as well as the chlorite, are *in situ*. But there are thousands of tons of stones, principally rolled quartz, scattered over the surface, on both sides of the rivulet, forming an irregular pavement, which are evidently *out of place*. They were, unquestionably, transported hither by the impetuosity of the current from higher lands, where they had their origin.

The water, at the time of our visit to the rapids, was uncommonly low. At the head of the falls we measured the brook, and found it only *two feet and four inches wide*, and *three inches deep*. At high water it covers an area about two rods in width. At the point where the rivulet is most contracted, it takes a perpendicular leap of eight feet and ten inches into an oblong basin, which we ascertained to be seventeen feet in width. This capacious basin has, manifestly, been formed in the chlorite rock, solely by the incessant friction of the water. From the south side, where the basin is open, the water flows off calmly in a canal in the rock, a few inches wide, and regular, as if cut by the chisel, for two or three rods, and then precipitates itself into a second cavity, eighteen feet in width and fifteen in depth, produced, evidently, in a manner similar to the first. The water, after travelling about six miles farther, has formed another basin, still larger, but less deep, than the last; its width being twenty-six feet and its depth twelve.

There is a succession of cavities, or basins, at small intervals, for a distance of three hundred and thirty paces, or nearly one fourth of a mile. They are all wrought in the solid rock. Their forms are very dissimilar; some resembling a deep pot, and others an immense oven, inverted. We observed but a few small cavities, such as are generated in the Connecticut river, at Bellows Falls, by the rolling of a single stone.

I am aware, that the traveller who visits this spot at the season we did, will, at once, pronounce this puny brook totally inadequate to the production of these wonderful cavities. But his sentiments will alter, when he considers that a vast stratum of snow falls, annually, on the Green Mountains; which, when it dissolves in the spring, swells this rivulet, during a number of weeks, to a mighty torrent. Marks

of violence are every where visible in the large collections of logs and brushwood, and even of whole trees, accumulated in various places, and in the transportation of ponderous quartz stones for many miles, and in the heaving of them up, on high masses of chlorite and mica-slate, to which they have no relationship.

Should you, sir, ever find it convenient to cross the Green Mountain from Windsor to Middlebury, I hope you will take the trouble to view this admirable specimen of nature's workmanship. The labor will, I assure you, be richly rewarded.

Your very obedient

F. HALL.

BOTANY.

ART. VII.—*Diversity of the two sorts of Datura found in the United States.*

Two sorts of *Datura*, which present considerable differences to the eye, are well known to be common in many parts of the United States. One of these has been generally supposed by botanists to be the *Datura-Tatula*, and the other the *Datura-Stramonium* of Linne. Their specific diversity, as far as I am informed, remained unquestioned till Dr. Bigelow advanced the opinion that they are mere varieties, and stated the concurrence of Sir James Edward Smith, who, it seems, made his decision from an examination of the specimens in the Linnæan Herbarium. Mr. Elliott has since expressed his doubts upon the same subject.

Although most of the principal authorities, such as Linne, Gmelin, Willdenow, Persoon, Turton and many others in Europe, and likewise Muhlenburg and Pursh, in America, are in opposition to the opinion under consideration, yet, as there can be no question that the decisions of the gentlemen above mentioned are entitled to the highest respect, I should not at this time venture to suggest any doubts of their correctness in the present instance, had not long-continued and close observation convinced me, that they are, in fact, perfectly distinct.

I have no hesitation, however, in admitting the inadequacy of the distinguishing marks which have been selected by every writer with whom I am acquainted. The erect spinous pericarps, the ovate or, if flattened, the cordate and sharply dentate and glabrous leaves are unquestionably common to both the American sorts. Even *most* of the additional circumstances which are commonly mentioned incidentally, are nearly uniform in each. The *D. Tatula*, although occasionally larger and less slender than the *D. Stramonium*, is by no means generally so, nor is there a regular and uniform appreciable difference (indeed it is scarcely ever to be observed in American specimens,) between the length of the flowers and the turgidness of the perianth of the two sorts; in both, the stalk is generally smooth and divided at an acute angle, the leaves are as sharply dentate and as much sinuated in one as the other, and in some instances they are both attenuated into the petiole, or both, as it were, truncate at the base. In the smaller plants of each sort, the stem is commonly pithy, and in the larger of each, it is hollow.

The white corol of the one, which verges to a cream color, and the pale blue or light purple of the other, striped with deep purple on the inside, are indeed almost always observable, but not sufficiently prominent for distinction; but the *purple stalk sprinkled with green points* in the one, and the uniform *green stalk* of the other, I have reason to think, are invariable and permanent.

I have been many years in the habit of observing the two sorts and noticing this difference, and for ten years at least, I have viewed them closely, in reference to their distinction of species. My observations have been made both where they grew entirely separate, and where they grew together, and I have cultivated them in both situations, without ever being able to discover the least approximation of the one to the other, or to detect any intermediate specimen; and contrary to my expectations, I have never seen, among the plants produced from seeds, and growing together, any evidence of promiscuous impregnation and the production of hybrids. Even in the spring season, the last year's dead and half decayed plants of each sort, may always be distinguished with perfect facility.

In places where only one sort has been common, time immemorial, I have never known the other make its appear-

ance, when it could not be decidedly traced to some other place, where it was previously known to grow. Thus, there was none of the pea-green sort in New-Haven, till introduced by Professor Ives, nor in Middletown, till brought from the meadows of Wethersfield, where it has long been common, by the ice which was deposited in such immense quantities, by the freshet of 1818.

In fact, I find the strongest reasons for concluding that there are as fixed and permanent specific distinctions between what has been supposed in this country, to be *D. Tatula*, and what has been considered *D. Stramonium*, as are to be found in the science of Botany. I am well aware that the maxim, that for the distinction of species, regard is not to be had to *color*, size, taste, smell, or to the external surface, is, *in general*, correct; but as there is no one of those characters which are commonly the most permanent, that is not occasionally variable, so too rigid an adherence to the above principle, may lead to error. *Color*, at least, when established by sufficient observation to be permanent, I think may be safely assumed as a specific character.

Were I to define the term species, I should say it denoted *all such individuals as are alike in every characteristic which is incapable of change by climate, soil, cultivation, time, or in short any accidental cause, and which is permanent and continued by propagation from seeds*. If this is correct, a species may be distinguished by *any* uniform and invariable peculiarity which is thus perpetuated, and no two differing individuals are to be considered as mere varieties, unless their peculiarities are changeable and evidently occasioned by soil, climate, cultivation, or other accidental causes, and are by no means to be certainly perpetuated by seeds.

If then the colour of the stalks of the two sorts of *Datura* in question is once established by adequate observation, to be permanent and invariable peculiarities, it is, in my view, sufficient. The similarity of the plants in other respects, falls far short of proving them to be only varieties, as it is well known that distinct species often so nearly resemble each other, as that their claim to distinction, can be established only by long-continued, and close comparative examination; and on the other hand, varieties are occasionally so diverse, that equal pains is necessary to establish their specific identity. The great similarity of the different spe-

cies of *Trillium*, *Erythronium*, *Statice*, *Actæa* and of a vast number of other genera, has long been a fruitful source of discrepancy among botanical authors, and a multitude of instances may be specified, in which plants for a long time, not even considered as distinct varieties, have ultimately been found to be different species, as for instance, *Veratrum-album* and *viride*. *Berberis-vulgaris* and *Canadensis*, etc. etc.

Although I have never seen any other species of the genus *Datura*, yet judging from the descriptions given by authors, I am inclined to think that there is much of this close similarity and affinity, between several of them, and although it was not my intention to raise any question at this time, except respecting the two American plants, yet I cannot forbear remarking in this place, that if the best representations of the European *Stramonium* are correct, there is some ground for suspecting at least, that the *Stramonium* of that region, is specifically distinct from either of the sorts found in America. I have formerly compared our plants with Woodville's plate, and I now very well recollect the conclusion, without being able to specify the precise reasons. At present I have only a wood cut of Bewick before me, which appears at least, to be very well executed, and which to the best of my recollection, corresponds to the engraving of Woodville. In this, the shortness and inflation of the perianth, the companulate rather than the infundibuliform corol, the round-oval form of the anthers, and the greater width and shortness of the leaf, are prominent peculiarities. I have certainly never met with any American specimen that possessed, or even approximated to them, and I think the European and American sorts ought still to be diligently compared in their living state. If they are distinct, it is most probable, that more definite peculiarities may be found, but even if there should not be, still, provided these should prove uniform, invariable, and permanent, it might *possibly* warrant considering them distinct. I am no advocate for the hasty and careless multiplication of species, and till decisive and distinct marks can be found, those which are closely allied, should by all means be considered as varieties. In the present state of my information, however, I cannot but view the two American sorts of *Datura* as *specifically* distinct, and I believe this has long been the declared opinion of Professor Ives of Yale-College, and some

others whose attention has been particularly turned to the subject for some years past. Under this impression I shall venture to suggest an emendation of the specific characters of the plants in question, in the following terms, viz.

Datura Tatula, caule purpureo punctis viridibus asperso, pericarpis spinosis erectis ovatis, foliis ovatis dentatis glabris.

Datura Stramonium, caule viridi, pericarpis spinosis erectis ovatis, foliis ovatis dentatis glabris.

The facts that the corol of *D. Tatula* is generally pale blue, or purple striped with deep purple inside, and that of *D. Stramonium* white varying to cream colour, ought to be added by way of observation.

The *Datura* from the Cape-of-Good-Hope, which has been lately called *Tatula*, must, without doubt be considered as entirely out of the question in this discussion, and even if the European and both the American plants, be ultimately decided to be mere varieties, that ought unquestionably to have another name.

Middletown, (Conn.) Jannary 1821.

CONCHOLOGY.



ART.—VIII.—*On the Genera Unio and Alasmodonta; with Introductory Remarks: by D. H. BARNES, M. A. Member of the New-York Lyceum of Natural History.**

(Concluded from pa. 127.)

UNIO.

** Cardinal teeth moderately thick, direct.

OBSERVATIONS.

THE shells of this section are, in general, not *very thick*. They have the *beaks* slightly elevated, or nearly flat. The

[*Read before the Lyceum.]

external surface is neither waved nor tuberculated. The *teeth* are less sulcated than those of the former, and only crenulated, or striated, generally triangular and elevated, and, in magnitude, bear a proportion to the thickness of the shell. The *cavity* of the beaks is small, or none, and neither angular nor compressed. The shells have a smooth and regular appearance, and five of the seven species have the inside purple.

SPECIES.

10. UNIO ELLIPTICUS. Fig. 19. $\left\{ \begin{array}{l} a. \text{ outline} \\ b. \text{ of} \\ c. \text{ four} \\ d. \text{ sizes.} \end{array} \right.$

Shell regularly oval, thick, convex, glabrous, beaks depressed. Teeth elevated, triangular, striated.

Unio Crassus. Mr. Say. Plate 1 fig. 8?

Mya Compladata? Dillwyn. page 51.

Inhabits Fox River. Mr. Schoolcraft.

Dr. Mitchill's Cabinet.

My Collection.

Diam. 1.0—2.0 Length 1.7—3.2 Breadth 2.5—4.9 inches. Shell long before, and short behind, equally rounded at both extremities; *beaks* nearly flat; *ligament* elevated above the beaks; *epidermis* yellowish brown, obscurely rayed, rays disappearing in old specimens; slightly flattened on the *anterior slope*; *teeth* deeply divided, elevated, finely striated; *anterior cicatrix* wrinkled; *posterior* rough; *cavity* of the beaks considerable. *Naker* pearly white, iridescent, and sometimes, of a beautiful flesh colour.

11. UNIO CARINATUS. Fig. 10. $\left\{ \begin{array}{l} a. \text{ inside.} \\ b. \text{ outside.} \end{array} \right.$

Shell oblong oval, biangulate before, rayed, hinge margin straight, compressed, keel-shaped, teeth finely striate.

Inhabits Fox River. Mr. Schoolcraft.

Dr. Mitchill's Cabinet.

My Collection.

Diam. .7—1.3 Length 1.2—2.3 Breadth 2.1—3.7 inches.

Shell transversely elongated, sub-pentangular, moderately thick, rounded behind; *beaks* slightly elevated, approximate; hinge margin straight, elevated, compressed, keel-shaped, longitudinally furrowed, fuscous with submembranaceous striæ; anterior dorsal margin straight and subtruncate; basal margin rounded; *epidermis* greenish yellow, with broad dark green rays; *surface* glabrous. Cardinal teeth slightly striated, nearly smooth; posterior cicatrix deep and striated; naker very white, iridescent.

Variety (a) *obscurely* rayed, more convex, compressed on the base, and gaping behind.

Inhabits Lake Champlain.

My Collection.

REMARKS.—This is a beautiful species. It cannot be confounded with any of the varieties of the *Curiosus* or *Radiatus*, on account of the primary teeth, which are entirely different. We have so many specimens of this shell, and they are all so perfectly characterized, and so much alike, that there can be no doubt of its being entitled to a distinct appellation. In several of the specimens, the epidermis is worn off, exhibiting a flesh-coloured substance beneath.

12. UNIO ALATUS.—Shell ovately triangular; hinge margin elevated into a large wing; valves growing together on the back of the ligament, inside purple.

Unio Alatus. *Mr. Say.*

Unio Alata. *M. Lamarck.*

American Conchology, plate 4. fig. 2.

Inhabits Fox River. *Mr. Schoolcraft.*

Wisconsin. *Capt. Douglass.*

Cabinets of the Lyceum and Dr. Mitchell.

We have every size of this shell from one inch to six inches and nine tenths broad. A full grown specimen measures as follows, viz.

Diam. 2.0 Length 4.7 Breadth 6.9

A middle aged and very splendid specimen measures
D 1.6 L 4.0 B 6.0

Shell moderately thick; disks flat and compressed, long before and short behind; *beaks* depressed; *ligament concealed* within the valves; *hinge margin* very much elevated and compressed; basal margin nearly straight; anterior dorsal margin incurved or emarginate; anterior margin rounded and broad; posterior margin rounded and narrow; surface deeply wrinkled. Teeth elevated and crenate; anterior cicatrix very broad; posterior composed of three distinct impressions, two small ones before the large one, and also a row of very small impressions across the cavity of the beaks, before the cardinal tooth. Naker red-purple and very brilliant; cavity of the beaks small and indented with from six to ten minute impressions in a row nearly longitudinal.

REMARKS.—The hinge margin is less elevated, and the colour less brilliant, in old than in young and middle aged specimens. The former approach the regular oval form, the latter are broad ovate.

None of the specimens in our collections exhibit the character mentioned by Mr. Say, viz. "the external laminated tooth obsolete, only one in each valve being perceptible;" and the tubercles, mentioned by him on the inside, appear only in very old specimens.

M. Le Sueur thinks that the remarkable union of the valves above the ligament ought to characterize a distinct genus. This union can seldom be observed in Cabinet specimens, as the part is very fragile. Of the numerous specimens in our collections, *one only* retains the full elevation of the wing; the rest having been broken in transportation. This is the most splendid species of the *Unio* yet known. and it is so remarkably characterized as readily to be distinguished from all others, except perhaps the *Unio Gracilis*; which, though perfectly distinct, might, at first view, be mistaken for the young of this species.

13. UNIO PRÆLONGUS. Fig. 11. { outline of
three sizes.

Shell much elongated transversely, narrow, thick, tumid, beaks flat; lateral tooth long, thin; inside purple.

Shell very long oval; anterior side somewhat pointed, posterior side short, rounded, obtuse; beaks depressed; *ligament* elevated above the beaks; basal margin slightly compressed, shortened, or, in old specimens, arcuated; in young rounded; *epidermis* blackish brown, with fine interrupted wrinkles placed in longitudinal rows, having somewhat the appearance of striæ. Young specimens are rayed with yellowish olive, and have the epidermis smooth and glabrous. Naker purple of different shades according to the age or perfection of the specimen, sometimes tinged with irregular spots of greenish, particularly under the beaks, with a row of small muscular impressions in the cavity.

Variety (a.) Shell on the *inside striated* longitudinally. Naker red-purple, very splendid.

My Collection.

Shell elongated transversely, thick, gibbous; lateral tooth very thick, incurved, inside purple.

My collection. Lyceum's Cabinet.

Mr. Say's Collection. Philadelphia.

Shell much elongated transversely, *thick and heavy*, rapidly narrowed and rostrate before, narrow and rounded be-

hind, *sub-cylindrical*, disks somewhat compressed; anterior side very much produced; beaks flat; ligament elevated; anterior dorsal margin depressed and flattened; basal margin nearly straight; *epidermis* blackish brown, finely striated and deeply wrinkled transversely; naker purple of different shades, often with a purple centre and white margin. Teeth crenate; lateral tooth rough, very thick, bending downward, terminating abruptly and folded over towards the interior of the shell.

REMARKS.—This shell in many respects resembles the preceding, but it differs from it in being less, thicker in proportion to the size, more attenuated before; and it may be distinguished from all others by the unusual *thickness* of the *lateral tooth*. It is also more depressed immediately behind the beaks, and the thickness of the *anterior part* of the shell is very unusual, being in some specimens greater than that of the posterior. In one specimen the lateral tooth of the left valve measures *two lines* in thickness, and the channel of the opposite valve is two and a half lines broad.

15. *UNIO CUNEATUS*.—Shell ovate wedge-shaped, thick, gibbous; disks swelled, anterior lunule furrowed; lateral tooth thin; inside purple.

Inhabits the Ohio. Mr. S. B. Collins.

Mr. Collins's collection.

Diam. 1.6 Length 2.3 Breadth 3.8

Shell elongated and sub-triangular, thick and ponderous; anterior side narrowed, thin, angulated, wedge-shaped, compressed; umbones large and somewhat elevated; beaks low and distant; anterior lunule long-heart-shaped, large, distinct with an elevated ridge and longitudinally furrowed; posterior lunule small and deep; basal margin slightly rounded; anterior margin narrow and angulated; anterior dorsal, rapidly narrowed; posterior dorsal impressed; *epidermis* blackish brown, somewhat ferruginous; surface finely wrinkled, an elevated ridge extends from the beaks to the anterior basal margin, and terminates in an angle on the fore part. Cardinal teeth deeply divided and sulcated; lateral tooth long, curved, and not very thick; cicatrices deep; cavity of the beaks small and not angular; naker brownish purple, iridescent.

REMARKS.—This shell differs from the foregoing one, in its outline, in its greater length, less breadth, and in being more triangular. In *that* the lunules are not distinct; in *this* they are strongly marked. The lateral teeth of the two differ in length, thickness, direction and surface. This shell, if the thickness only were observed, might be mistaken for a variety of the *Crassus*; but the teeth are totally different.

16. UNIO PURPUREUS.—Shell not very thick, obliquely sub-truncate before; beaks depressed; epidermis without rays, glossy;

Unio Purpureus. *Mr. Say.*

Unio Purpurascens. *M. Lamarck.*

Unio Rarisulcata ?

Unio Coarctata ?

Unio Rhombula ?

Unio Carinifera ?

Unio Georgina ?

M. Lamarck.

American Conchology, Plate 3. Fig. 1.

Inhabits Lakes and Rivers eastward of the Alleghany mountains.

Cabinet of the Lyceum. My collection.

The varieties, which are exceedingly numerous, differ very much from each other in the length of the diameter, some measuring 13 lines, and some only 5. The length and breadth are generally in the proportions of 3 to 5. Mr. Say's figure measures length 1·4, breadth 2·6, and many specimens are twice as broad as they are long.

Diameter 1·3. Length 2·5. Breadth 4·5.

Inhabits Stony Creek, near Princeton, N. J. *Mr. Sears.*

1·1 1·8 3·45

Inhabits the Kayaderosseras.

·75 1·5 3·0

Inhabits the Housatonic.

Shell sub-oval, ovate-oblong, ovate—rhomboidal, oblong-ovate; thin, or not *very* thick; disks convex, convex-depressed, or somewhat compressed; before somewhat angulated or rounded obliquely; base rounded, straight, a little shortened, depressed. sub-sinuate, or coarctate-sinuate; *beaks* not prominent; hinge margin elevated, compressed.

carinate or depressed; epidermis has generally a *silky lustre*; surface with smaller wrinkles placed between larger ones, or with transverse elevated distant furrows, or smooth; cardinal teeth small, or not very large, sulcated or striated; naker livid, cerulean, green, purple, red, violet, white, with various shades and mixtures of these colors; no *cavity* under the beaks.

REMARKS.—The terms of the foregoing general description are taken from *Mr. Say's* and from the six species of *M. Lamarck* mentioned above. This is a very common shell, of a regular and uniform appearance, without prominence of parts, or strongly marked characters; which perhaps induced *M. Lamarck* to say "it is nothing remarkable."* Amidst a variety almost infinite, like that of the human countenance, there is still a characteristic identity of this species, which can scarcely be mistaken by an experienced observer. One variety of the *Radiatus* from the Saratoga Lake approaches nearest to this species, but the *least appearance of rays* forbids its association.

* * * *Cardinal teeth small, direct.*

17. UNIO RADIATUS.—Shell broad-ovate, thin, finely striated, glossy rayed, within bluish white, or tinged with red.

Unio Ochraceous. *Mr. Say.*

Mya Radiata. *Mr. Dillwyn.*

Unio Radiata. *M. Lamarck.*

American Conchology, plate 2, fig. 8.

Inhabits lakes and rivers of North-America.

Cabinet of the Lyceum. My collection.

Diam. .6—9 Length 1.2—1.5 Breadth 2.0—2.5.

Shell with the anterior side broad, thin and fragile, disks in old specimens somewhat convex; in young, depressed; beaks slightly elevated and approximate; ligament elevated; hinge margin elevated, compressed, carinate; basal margin commonly a little depressed, and sometimes arcuated; anterior margin narrow; posterior broad; anterior dorsal sub-truncate; epidermis greenish yellow or olive-brown, rayed with dark green, and very finely striated trans

*See An. Sans Vertebres, Vol. VI. p. 74. U. Georgia.

versely; surface smooth and shining. Cardinal teeth crenulated, cavity of the beaks small; naker bluish white, or reddish yellow; surface smooth and pearly.

Variety (a) very obscurely rayed and much like *Unio Purpureus* in shape.

Inhabits Saratoga Lake.

Variety (b) oval or very nearly as broad behind as before.

Inhabits the Wisconsin. *Capt. Douglas.*

18. *UNIO MUCRONATUS.* Fig. 13. } outline of the shell.

Shell ovate, broader behind; base compressed, falcated; beaks small, elevated, *acute*, inside purple.

Inhabits the Wisconsin. *Capt. Douglass.*

My collection.

Diam. .7 Length 1.3 Breadth 2.3.

Shell ovate, moderately thick, produced, narrowed, and compressed before; rounded and broad behind; disks compressed; anterior lunule long, distinct, with a marginal furrow; posterior lunule small, deeply impressed; hinge margin rounded; basal margin arcuated; anterior dorsal rapidly narrowed and slightly emarginate; epidermis horn-color, and obscurely rayed; surface smooth; cardinal teeth serrate sulcate; cicatrices deep; naker purplish on the margin, and whitish in the centre.

REMARKS.—This species has somewhat the outline of the *Unio Tuberculatus*, but the outside is smooth. The individual above described is probably not more than half grown, as the umbones are very little eroded.

19. *UNIO INFLATUS.*—Shell oval, thick, tumid, beaks broad, obtuse behind, wedge-shaped before, inside pearly white.

Inhabits the Wisconsin and Lake Erie. *Capt. Douglass.*

Dr. Mitchill's Cabinet.

My collection.

Diam. 1.4 Length 1.7 Breadth 3.2.

Shell about equally broad before and behind, thick and very much swelled, the diameter being almost equal to the length; beaks broad round and somewhat elevated; posterior side very short and obtuse; anterior side wedge-shaped produced. Hinge margin nearly straight, and parallel to the base; basal margin straight and slightly compressed in the middle; epidermis yellowish-green, rayed; surface wrinkled and striated transversely; cardinal teeth elevated, pointed, sulcated; lateral teeth papillous; posterior cicatrix deep, and somewhat rayed with elevated lines; cavity of the beaks moderate; naker pearly white and iridescent; internal surface papillous.

REMARKS.—This shell is less than the *Unio Siliquoideus*, and also more rounded and gibbous, shorter behind and proportionally longer before than that species. The varieties of the two species approach each other, and are to be distinguished only by the teeth.

B. TEETH OBLIQUE.

* * * * *Cardinal teeth, broad, oblique, compressed.*

20. *UNIO VENTRICOSUS*. Fig. 14. $\left\{ \begin{array}{l} a \text{ small size.} \\ b \text{ large size.} \\ c \text{ the first variety.} \end{array} \right.$

Shell large thick triangularly ovate, convex; umbones large, round, prominent; beaks recurved; cavity capacious.

Mya Radiata. *Dillwyn's Letter to Dr. Mitchell.*

Unio Cariosus. *Mr. Say's Letter to the Author.*

Inhabits the Wisconsin. *Mr. Schoolcraft.*

Mississippi, near Prairie du Chien. *Capt. Douglass.*

Cabinets of the Lyceum and Dr. Mitchell. *My Collection.* *Mr. Say's Collection, Philadelphia.*

Diam. 2.5 Length 3.5 Breadth 4.5.

Shell with the anterior side very broad, sub-truncate; posterior side rapidly narrowed, sub-angulated; disks very convex; umbones large, round, elevated; beaks recurved

over the ligament; ligament large and prominent, passing under the beaks; anterior lunule depressed at the margin, fuscous, broad-heart-shaped, longitudinally waved; hinge margin depressed between the beaks; posterior slope carinate; epidermis yellowish olive, becoming chesnut brown on the umbones; rayed with green, more conspicuous in young specimens; in old ones the dark chesnut brown covers the whole and conceals the rays; surface smooth and shining, reflecting the face of the observer; young shells are splendid, having a much stronger lustre on the outside than on the inside; cardinal teeth broad, prominent and obliquely flattened; lateral teeth broad, elevated and terminating abruptly before; cicatrices large; cavity of the beaks unusually large; naker pearly white; surface smooth, but not highly polished.

REMARKS.—There is a remarkable uniformity in the dimensions of the full-grown specimens of this species. This shell is more capacious than any other of the genus hitherto described. It most resembles the *unio ovatus*, but its greater capacity, darker color, its smooth, shining and rayed surface will distinguish it without mistake.

Variety (a) shell broader, less ovate, nearly oval and rounded on both sides.

A fine large shell. It measures

Diam. 2.3—2.8 Length 3.1—3.8 Breadth 4.1—5.4.

Inhabits the Wisconsin. *Mr. Schoolcraft.*

Variety (b) shell light green, rayed, compressed.

Inhabits the Wisconsin.

Variety (c) shell with the teeth slightly elevated; cardinal one formed by a serrated edge of the shell, and a slight projection within.

Inhabits Barbadoes Neck, N. J. near New-York.

Mr. Bradhurst's Collection.

Diam. 2.5 Length 3.5 Breadth 4.8.

Variety (d) a shell from the Delaware approaches this species. The form and colour are similar. It is however less, the largest measuring scarcely 2.3 inches broad; making the shell not more than one fifth the size of those described above; also the beaks and bosses are less promi-

nent, the rays fewer, and the polish less brilliant. It approaches the *Unio Cariosus*.

Inhabits the Delaware at New Hope. Mr. J. Sears.
My Collection.

REMARKS.—With the most respectful deference to the two distinguished Naturalists whose names are mentioned above, I have ventured to differ from them both, as they do from each other. I think a slight examination of our Cabinets would convince either of them that this shell requires a separate designation. Two bivalves can scarcely be more unlike than this and the *Unio Radiata* of Lamarck; and the recent discovery, of the variety C, in our own waters, which produce thousands of the *Unio Cariosus*, seems conclusive as to that. This variety it will be observed has *precisely the same diameter and length* as the shell from the Wisconsin, and the difference in the teeth may be accidental. There is the same necessity for distinguishing these as any others. They are totally unlike.

21. UNIO SILIQUOIDEUS. Fig. 15. { outline
of the
shell.

Shell long-ovate, sub-cylindrical, thick, regularly rounded, rayed, beaks slightly elevated, cavity small; inside white.

Inhabits the Wisconsin. Capt. Douglass.

Dr. Mitchell's Cabinet. My Collection.

Diam. 1.3—1.6 Length 1.8—2.1 Breadth 3.3—3.8.

Shell elongated transversely, disks swelled; beaks about one fourth from the posterior extremity; hinge margin straight; basal margin convex depressed; anterior margin rounded; posterior sub-angulated; epidermis yellowish olive rayed with distant dark green narrow lines; surface deeply wrinkled, and somewhat imbricated; striæ dark and lamellar on the anterior slope; smooth and bright on the centre of the disks; cardinal teeth elevated crest-like compressed, and very oblique; in some specimens nearly parallel to the edge of the shell; lateral teeth long and

straight; cavity of the beaks small and rather shallow, naker pearly white and iridescent, surface smooth and polished.

Variety (a) shell less, more ovate, broader before, hinge margin more elevated.

REMARKS.—This is a beautiful and elegantly formed shell. It somewhat resembles a *pea-pod*; hence its name. It agrees in color and surface with the *Unio Ventricosus*, but differs in being of smaller size, longer in proportion, more cylindrical, less inflated, beaks much less elevated, and cavity less capacious.

22. *UNIO OVATUS*.—Shell roundish-ovate, convex, umbones elevated, beaks recurved, anterior lunule flattened; teeth crest-like elevated.

Unio Ovatus. *Mr. Say.*

Unio Ovata. *M. Lamarck.*

Inhabits the Ohio. *Mr. Collins.*

Maumee, at Fort Wayne. *Mr. Sears.*

Mr. Collins' Collection. *My Collection.*

Diam. 1.6—2.0 Length 2.3—3.0 Breadth 3.3—4.0.

American Conchology, plate 2, fig. 7.

Shell usually broader before, and narrower behind the beaks; but in the figure referred to above, the contrary is observed; thin when young, and not remarkably thick when old; disks swelled; umbones prominent; ligament partly concealed; anterior lunule flattened, and fuscous, somewhat waved with striæ and wrinkles becoming lamellar; hinge margin making an angle with the anterior and posterior dorsal; epidermis yellowish, or horn color; surface glabrous, deeply wrinkled, wrinkles appearing on the inside; cardinal teeth crest-like, elevated and compressed; lateral teeth elevated; in some specimens, short, crooked, and apparently deformed; in others, straight; cicatrices smooth and polished; cavity large and rendered somewhat angular by the flattening of the anterior slope; naker pearly, bluish white; surface, in old specimens, papillous, in young, smooth.

REMARKS.—The angular appearance produced by the flattening of the anterior slope, readily distinguishes this

species. It most resembles the *Unio Ventricosus*; but is less, thinner, "more flattened and even slightly concave on the anterior slope, from the oblique carina to the angle at the termination of the ligament." Mr. Say says the *Ovatus* is not rayed, and our specimens accord with his description, but M. Lamarck mentions a variety with rays from Lake George.

23. *UNIO CARIOSUS*.—Shell ovate or oval, inflated, not very thick, beaks somewhat prominent, cavity moderate.

Unio Cariosus. Mr. Say.

Unio Cariosa. M. Lamarck.

Inhabits Lakes and Rivers of N. America.

My Collection.

Diam. 1·6, Length 2·3, Breadth 3·7.

American Conchology, plate 3, fig. 2.

The dimensions and description of this shell vary so much that it is difficult to find a sufficient number of permanent characters by which it may be distinguished. It resembles in this respect the *Unio Purpureus*; for of the twelve characters mentioned by Mr. Say, and the six mentioned by M. Lamarck only four can be considered as in any degree permanent; and of these M. Lamarck has mentioned but one, and that is "inflated." The colour, form and size of the shell constantly vary. It is commonly broader before, but often equally broad at both extremities; and somewhat pointed. It is never very thick; often very thin; commonly a medium. Those from the Hudson are thin and small, from the Raritan thicker and broad; from the western waters middle sized and of considerable thickness; disks swelled, umbones elevated; ligament exterior and elevated; epidermis olive-brown or greenish, and commonly radiated. Internal colour bluish white, reddish, rose, or salmon; surface often warty.

Variety (a) Cardinal teeth multipartite.

Inhabits Lake Ontario.

Mr. Bradhurst's Collection.

Of this remarkable shell we have four specimens ;

Diam. .6 Length .625 Breadth 1.05 inch.

.625 .7 1.1

.75 .8 1.5

.8 .8 1.3

Shell moderately thick, acutely angulated before obtuse and somewhat angulated behind ; disks inflated ; anterior slope flattened and forming a right angle with the disk, ribbed longitudinally and wrinkled transversely ; beaks one third from the posterior extremity, decorticated approximate and somewhat elevated ; anterior lunule oval-heart-shaped ; posterior lunule not distinct ; basal margin a little depressed near the anterior extremity ; anterior margin straight, and its edge not entire ; epidermis yellowish-green, rayed with dark green, finely striated transversely, and with from three to six more conspicuous transverse wrinkles. Anterior slope marked with longitudinal ribs which are beautifully cancellated by the striæ and wrinkles passing over them, ribs projecting and forming a dentated edge ; shell slightly gaping at both extremities ; cardinal teeth two in each valve, compressed and crenulate, lamellar teeth short, projecting, finely crenulate, and terminating abruptly ; naker bluish-white iridescent.

REMARK.—This shell resembles, in shape, the *Alasmodonta marginata*, but it is a well characterized *Unio*.

26. *UNIO NASUTUS*.—Shell oblong-lanceolate, thin produced and pointed before, hinge margin elevated, compressed, carinate.

Unio Nasutus. Mr. Say.

American Conchology, plate 4, fig. 1.

Inhabits the Delaware.

My Collection.

Diam. .5 Length 1.0 Breadth 2.2.

Shell thin and slender ; disks compressed ; beaks depressed ; ligament elevated and slender ; anterior lunule distinct, somewhat depressed at the margin, and with obsolete longitudinal ribs ; hinge margin straight ; basal margin nearly parallel with the hinge, slightly divergent ; anterior

extremity pointed, posterior rounded; epidermis greenish brown; surface striated, glabrous; cardinal teeth slender; lateral tooth long and thin; naker bluish-white varied with wax-yellow, and sometimes tinged with violet, and iridescent; cavity of the beaks, scarcely any.

REMARK.—This cannot as M. Lamarck supposed be his *Unio Nasuta*, for it has no sinuses on the basal margin, is not “crooked” nor “obliquely attenuated.”

27. *UNIO GRACILIS*.—Shell ovately triangular, very thin and fragile, hinge margin elevated; valves connate; ligament concealed.

Unio Alatus. *Mr. Say.*

Inhabits the Wisconsin. *Mr. Schoolcraft.*

And the Lakes. *Mr. Say.*

Cabinet of the Lyceum.

My Collection.

Diam. 1·0—1·2 Length 2·2—2·5 Breadth 3·1—4·1.

Beaks depressed, and placed far back; ligament between the valves, and covered; anterior lunule distinct and obsoletely ribbed; hinge margin elevated into a large wing; epidermis sea-green, wrinkled and striated transversely; obscurely radiate and glabrous; cardinal teeth very small, scarcely projecting; lateral teeth very thin and finely striated; channel just sufficient to admit the point of the thumb nail; naker bluish-white tinged with violet, and beautifully iridescent.

REMARKS.—This shell differs from *Unio Alatus* in being much thinner, broader in proportion, lighter color both inside and outside, produced and somewhat pointed behind; anterior slope in a straight line with the alated projection. It differs entirely in the shape and proportion of the teeth.

28. *UNIO PARVUS*. Fig. 18. } outline of
the shell.

Shell oblong-ovate, small, convex, sides rounded; beaks slightly elevated, inside pearly white, iridescent.

Inhabits the Fox River. Mr. Schoolcraft.

Cabinet of the Lyceum.

Mr. Collins's Collection.

Mr. Say's Collection, Philadelphia.

Diam. .35— .525 Length .4— .6 Breadth .75—1.2.

Shell rather thin, beaks placed about one fourth of the length from the posterior extremity, ligament very narrow, anterior lunule distinct and obsoletely ribbed; basal margin slightly shortened; epidermis brownish; an obtuse slightly elevated rib from the beaks to the anterior basal margin; lateral tooth rectilinear rounded at the end, and parallel to the base; naker very brilliant.

REMARK.—The smallest and most beautiful of all the genus yet discovered in America.

Summary of the *Unio*.

Species described,	- - - - -	28
Varieties particularized,	- - - - -	23
		—
Total of species and varieties,	- - - - -	51
		—
Of which Mr. Say formerly described,	-	8
We have given new specific names to	-	20
Of which M. Lamarck had <i>perhaps</i> previously noticed	- - - - -	3

End of the *Unio*.

ALASMODONTA.*

Generick Character.

Shell transverse, equivalve, inequilateral, free; beaks decorticated; posterior muscular impression compound; hinge with prominent cardinal teeth in each valve, but without lateral teeth.

* "From α, without, λασμα (λεπισμα?) a scale, and οδον a tooth."—Mr. Say.

OBSERVATIONS.

This genus was established by *Mr. Say*. The shells are distinguished from those of the genus *Unio*, by the want of the lateral lamellar tooth, the place of which is commonly occupied by a slightly elevated fold; but no channel can be perceived, nor any interlocking or matching together of the opposite folds. In many specimens the part is perfectly smooth. The *sinus* at the anterior termination of the ligament is visible in all, and exactly resembles that of the *Unio*; as do also the colours of the epidermis and of the interior; but the polish of the inside is generally much less brilliant than that of the *Unio*. The habit of the shells is similar, many of them becoming thick and large.

M. Lamarck seems not to have noticed this genus. He makes the same remark of his *Hyria*,* that *Mr. Say* does of this, "that together with the *Dipsas* of *Dr. Leach* it completes the connexion between the *Unio* and *Anodonta*." But no part of his generick character agrees with the present genus except that the shell is equivalve, which is the case in the whole family.

The auricles† of his *Hyria* and the lamellar tooth forbid the supposition, that he could have intended this shell by his description. It is however properly one of his *Naiades*, and should be placed next to the *Unio*.

We subdivide the Genus into two sections, commencing with those that resemble the *Unio* and ending with those that approach the *Anodonta*.

Sections.

* Shells thick and large.

** Shells thin and small.

* Generick character of the *Hyria* of *M. Lamarck*. Shell equivalve, obliquely triangular, auriculate, truncated and straight at the base; hinge with two teeth slightly elevated; (*rampantes*.) the cardinal or posterior tooth multipartite, divergent, the interior parts less; the other or lateral tooth very long and lamellar; ligament external and linear. (Naker very brilliant.)

† The *Dipsas* of *Dr. Leach*, has the lamellar lateral tooth, but no cardinal teeth.

‡ Processes on each side of the beaks, like the scallop, *Pecten opercularis*.

* *Shells thick and large.*

Species.

1. ALASMODONTA ARCUATA. Fig. 20. $\left\{ \begin{array}{l} a. \text{ young, } c. \text{ old.} \\ b. \quad \quad d. \end{array} \right.$

Shell ovate, elongated transversely, thick; base arcuated; ligament elevated; beaks depressed; cicatrices rough.

Hab. West Canada Creek. Mr. R. N. Havens.

A small stream in Tappan. Mr. J. Sears.

Cabinets of the Lyceum and Dr. Mitchell.

My Collection. Mr. Say's Collection.

Diam. 1.2—1.6 Length 2.1—2.6 Breadth 4.1—5.5

Shell thick; disks convex above, and compressed below; anterior side very much produced; beaks slightly elevated; ligament elevated above the beaks; hinge margin elevated, compressed, carinate; basal margin *arcuated*; anterior margin narrow and somewhat pointed; posterior margin rounder and broader than the anterior; ant. dorsal margin rapidly narrowed and subtruncate; post. dorsal impressed behind the beaks; epidermis brownish black; surface, in young specimens, smooth and glabrous, in old ones, much eroded, scabrous and broken. Teeth *two* in the right and one in the left valve, triangular, elevated and crenate; muscular impressions rough; cavity of the beaks small; naker bluish white, on the fore parts, lightly iridescent, the rest dull. Young specimens have the center of a pale flesh colour, and old ones are frequently marked with irregular greenish spots.

REMARKS.—The remarkable change in the form of this species by age, as represented in the figures, might induce an observer to suppose that the shells belonged to different species; but the specimens in our collections of every variety of form, from those that are straight or even slightly *rounded* on the base, to those that are *deeply arcuated*, show clearly that they *all* belong to the same species. It is surprising that a shell so large, and frequently occurring in our waters should so long have been overlooked. This has

probably arisen from the supposition that it belonged to the genus *Unio*, as in its exterior it resembles some varieties of the *U. purpureus*.

2. *ALASMODONTA RUGOSA*.—Fig. 21. Shell oblong-oval, anterior side with deep divergent folds.

Hab. Wisconsin. *Capt. Douglass.*

Fox River. *Mr. Schoolcraft.*

Dr. Mitchell's Cabinet. My Collection.

Mr. Say's Collection.

Diam. 1.0 Length 2.0 Breadth 3.7

Shell oblong-oval, about equally broad before and behind; beaks slightly elevated, wrinkled and decorticated, exhibiting a wax colour beneath; ligament external and as high as the beaks; anterior lunule distinct with a slightly elevated ridge extending from the beaks to the ant. basal margin; basal margin a little shortened; the other margins regularly rounded; epidermis chesnut brown, with a silky lustre; *surface* of the anterior part folded in a *pinnate* form; *folds* deeper above and somewhat obsolete below the ridge, curved upward and extending to the hinge and anterior margins, indenting the edge and visible on the interior. *Teeth* large and elevated with a fold behind; cicatrices smooth; cavity small: naker pale flesh coloured in the center, pearly white on the margin with a narrow border of dark chocolate colour; surface smooth and glabrous.

REMARKS.—This is a very beautiful shell, and unlike any of its congeners. In the one figured, the left valve is slightly compressed, the right a little gibbous and the base crooked, which may perhaps be accidental.

3. *ALASMODONTA COMPLANATA*. Fig. 22. Shell ovately quadrangular, hinge margin elevated into a large wing; valves connate; ligament concealed.

Hab. Fox River. *Mr. Schoolcraft.*

Wisconsin. *Capt. Douglass.*

Cabinets of the Lyceum, and Dr. Mitchill. My collection.

Mr. Say's collection.

Diam. .9—1.4 Length from beaks to base 3.0 Breadth 5.0

Length from the top of the wing 4.3—4.5

Shell very short behind; disks much flattened; umbones depressed; beaks slightly projecting; ligament between the valves; anterior lunule much compressed and folded across the transverse wrinkles; hinge margin elevated into a large wing, straight and forming an obtuse angle with the post. dorsal margin; basal margin slightly rounded, nearly straight; anterior and posterior margins somewhat angulated; anterior dorsal margin arcuated, or somewhat emarginate; epidermis chestnut brown, glossy; surface somewhat deeply wrinkled and striated transversely; slightly elevated ridges and furrows diverging from the beaks to the anterior margin, and distinctly impressing the inside. Teeth elevated, sulcated and radiating from the beaks; cicatrices smooth; cavity small and angular; naker bluish white and iridescent; surface smooth, and polished, in old specimens spotted with green.

REMARKS.—This shell resembles the *Unio Alatus*, in the elevation of the wing and the connexion of the valves, and might at first sight be mistaken for a variety of that species; but it differs in generick character, in shape, and in colour.

*** Shells thin and small.*

4. ALASMODONTA MARGINATA.—See Mr. Say's description.

5. ALASMODONTA UNDULATA.—See Mr. Say's description and figure.

These two species were the only ones known when Mr. Say published his description. The former of them is very common and assumes a great variety of forms and colours. Those that were brought by the N. W. Expedition are larger than those of our eastern waters. They have the epidermis pale green, rayed; they are gibbous; have the beaks elevated, and base falcated.

Diam. 1.0 Length 1.4 Breadth 2.4

Our thanks are due to the following gentlemen, for specimens and information.

Gov. Cass of the Michigan Territory.

Capt. D. B. Douglass, Topographical Engineer to the N. W. Expedition.

Mr. H. R. Schoolcraft, Mineralogist to the N. W. Expedition.

Mr. Thomas Say, Philadelphia.

Doctor S. L. Mitchill,

Major Delafield,

Mr. S. B. Collins,

Mr. J. M. Bradhurst,

Rev. J. Sears,

Mr. R. N. Havens,

Mr. E. Norcross, of the American Museum.

} of New-York.

MATHEMATICS.

ART. IX.—*Demonstration of a Problem in Conic Sections.*
By Assistant Professor DAVIES.

Military Academy, West-Point, Jan. 20, 1823.

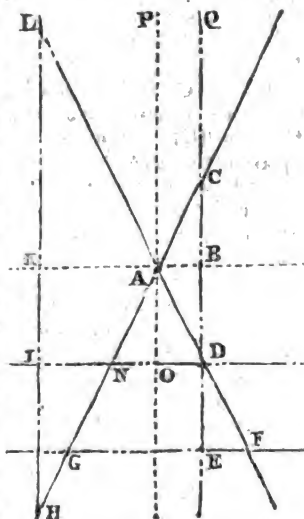
To the Editor.

SIR—In the first volume of Dr. Hutton's *Mathematics*, (second American edition. p. 470,) we find the following article—"If there be four cones, having all the same vertex, and all their axes in the same plane, and their sides touching, or coinciding in common intersecting lines; then, if these four cones be all cut by one plane, parallel to the common plane of their axes, there will be formed four hyperbolas, of which each two opposites are equal, and the other two are conjugates." The intersections of a plane, and the surfaces of four cones, having a common vertex, touching each other in right-lined elements, and having their axes in one plane, are not conjugate hyperbolas, as

asserted by Dr. Hutton; and the principle which he has adopted as general, obtains in one case only. As I have not seen this error corrected, nor any other method laid down by authors on conic sections for obtaining conjugate hyperbolas by means of intersecting four cones situated as above, I send you the following, thinking that it may possibly merit a place among the mathematical articles of your Journal.

Let LAC, HAF, HAL, and CAF, be four cones, having a common vertex A, their axes in the plane of the paper, and touching each other in the right-lined elements, CAH, and LAF.

If the two cones CAL and FAH be cut by a plane QCBDE, parallel to the line PO, it will intersect the cones in opposite hyperbolas; and if we take the plane perpendicular to that of the paper, these hyperbolas will be orthographically projected in the line EQ. If through either of the points C, or D, in which the cutting plane meets the right-lined elements AC, AD, another plane be passed parallel to the line KAB, this plane will intersect the two cones LAH and CAF, in opposite hyperbolas, and these hyperbolas will be conjugates to the former.



Demonstration.

Pass any plane as GF perpendicular to the axis of the cone GAF, it will intersect its surface in a circle, and the plane QE in a right line, which will be a common ordinate at the point E, to the transverse axis of the hyperbola, and the diameter GF of the circle. Since the triangles CAB, CGE and DEF are similar, CB is to AB as CE to EG, and CB is to AB as DE to EF; and by multiplying together

the corresponding terms of these proportions, we have CB^2 to AB^2 as CED to GEF . But the rectangle GEF is equal to the square of the ordinate of the circle or hyperbola at the point E , therefore AB is the semi-conjugate axis of the opposite hyperbolas, whose transverse axis is CD . Let now a plane HL be passed perpendicular to the axis AK of the cone HAL , it will intersect its surface in a circle, and the plane DI in a line; this line will be a common ordinate of the hyperbolas whose transverse axis is DN , and to the circle whose diameter is HL . Since the triangle DAO , DLI and HIN are similar, DO is to AO as DI to IL , and DO is to AO as IN to IH ; by multiplying the corresponding terms of these proportions, we obtain DO^2 to AO^2 as DIN to HIL . But the rectangle HIL is equal to the square of the ordinate of the circle or hyperbola at the point I , and therefore the hyperbolas having DN for a transverse axis have AO for a semi-conjugate. Since CB is equal to AO , and AB to DO , the transverse axis of the hyperbolas whose vertices are C and D , is equal to the conjugate axis of the hyperbolas whose vertices are D and N , as they are respectively equal to QCB and QAO , and the transverse axis of the latter hyperbolas, is equal to the conjugate of the former; the four hyperbolas are therefore conjugates.

It follows from this demonstration that, if either two of the opposite cones, be intersected by a plane parallel to their common axis, the distance of this plane from the axis, is always equal to the semi-transverse axis of conjugate hyperbolas, and that these hyperbolas may be formed by intersecting the other two cones by a plane parallel to their common axis, and at a distance from it equal to the semi-transverse axis of the first hyperbolas. The cutting planes are at unequal distances from the axes of the cones, to which they are respectively parallel, unless those axes make with the right-lined elements of their corresponding cones, angles of forty-five degrees, in which case the hyperbolas are equilateral, and may be cut out by one plane parallel to the axes of the four cones.

I am, Sir, with great
respect and consideration,
your obedient servant
C. DAVIES,
Asst. Prof. Nat. and Ex. Phi'y.

To Prof. B. Silliman, New-Haven.

ART. X.—*Elements of Geometry.* By A. M. LEGENDRE, *Member of the Institute and Legion of Honor, of the Royal Society of London, &c.*; translated from the French for the use of the students of the University at Cambridge, New-England. Cambridge, N. E. Hilliard & Metcalf, 1819. p. 208.

M. Legendre has long been regarded, as one of the great luminaries of mathematical science. His rectilineal and spherical trigonometry, appended to his *Elements of Geometry*, though not very extensive, is marked with profoundness and originality. His “*Essai sur la Théorie des Nombres*,” (of which the second edition, much larger and more complete than the first, was published at Paris in 4to in 1808,) contains the principal results of Fermat, Euler, and Lagrange, together with the fruit of his own investigations, upon that difficult and important branch of mathematics. It contains also some of the most interesting discoveries of M. Gauss, upon the same subject. The first elements of the “*Theory of Numbers*,” or, as it is sometimes called “*Transcendant Arithmetic*,” are demonstrated in the seventh book of Euclid, with elegance and rigor. We have some other ancient fragments on the properties of numbers, but this branch of mathematics has been much more cultivated by the moderns than by the ancients. Indeed, our system of Arithmetical Notation, which approaches perhaps as near perfection as any in this world, and the resources of our Algebra, have given the moderns an immense advantage over the ancients in investigating the general properties of numbers. Of the “*Theorie*” of Legendre, M. Gauss thus speaks: Dans cet intervalle, il a paru un excellent ouvrage d’un homme qui avait déjà rendu de très-grands services à l’Arithmétique transcendante, dans lequel il a non-seulement rassemblé et mis en ordre tout ce qui a paru jusqu’à présent sur cette science, mais ajouté beaucoup de choses nouvelles qui lui sont propres.* Besides these, he is author of a new method for the determination of the orbits of comets; Exercises upon the Integral

*Recherches Arithmétiques traduites par Delisle, preface p. 14.

Calculus; and various academical memoirs. In the late great trigonometrical surveys in France and England, operations which have contributed so much to our knowledge of the earth we inhabit, and to the honor of the nations engaged in them; the instruments used were of such exquisite construction, that the angles were measured to a fraction of a second. Hence, the spherical excess, that is, the excess of the three angles of the triangles, measured in these surveys on the surface of the earth, above two right angles, became apparent. It was necessary, therefore, to estimate this excess. The prompt genius of M. Legendre furnished for the occasion a theorem, founded on the fact, that the spherical triangles whose angles are measured in trigonometrical surveys, have their sides very small when compared with the radius of the sphere, which is, in this case, the radius of the earth. The theorem adverted to, reduces the resolution of these spherical triangles, to that of rectilineal triangles, and admirably unites conciseness with a sufficient degree of exactness. The theorem is this: "*A spherical triangle being proposed, of which the sides are very small in relation to the radius of the sphere, if from each of its angles one third of the excess of the sum of its three angles above two right angles, be subtracted, the angles so diminished, may be taken for the angles of a rectilineal triangle, the sides of which are equal in length to those of the proposed spherical triangle.*" M. Legendre has given a demonstration of this very valuable theorem, in the appendix to his Trigonometry.

The Elements of Geometry now under consideration, were composed during that period of the French history, when the ancient foundations of society and government were undermined, and the political edifice throughout Europe, rocked with fearful convulsions on its base. The great French philosophers and mathematicians saw plainly, that in order to conciliate the popular favor, and avoid the jealousy of the reigning authority, they must, as far as possible, render their favorite pursuits subservient to objects of immediate and practical utility. They had seen the eminent talents and conspicuous virtues of Lavoisier, insufficient to save him from the scaffold; and the illustrious but unfortunate Bailly, who had formerly been the idol of the French nation, and who had devoted his life to the inter-

ests of science and humanity, had fallen a victim of the most sanguinary tyranny, before their eyes. The subsequent organization of a system of public instruction, gave the French mathematicians an opportunity of rendering eminent services to the government. The utility of the exact sciences to the views of the French nation, as constituting the basis of the science of war, called into full exercise all the mathematical talents in the kingdom. But above all, the establishment of the National Institute concentrated the talents of the nation, and the pensions and high honors which were liberally bestowed, especially upon those who successfully cultivated the exact sciences, gave an astonishing impulse to mathematical learning. To these circumstances we owe the geometry of Legendre, the numerous elementary treatises of Lacroix, Laplace's *System of the World*, Lagrange's *Theory of Analytical Functions*, Poisson's *Mechanics*, and an immense number of other works of the highest merit, which cannot now be mentioned. The exact sciences are vastly indebted to the French revolution and its long train of consequences, whatever may be its ultimate effect upon the progress of knowledge in general. The science of calculation is now invested with such resources, that almost nothing is too complicated, or too stubborn to yield to its power.

Before proceeding to a particular examination of the work before us, we feel called upon to say a few words upon the enquiries,—what ought an elementary treatise of geometry to contain, in the present state of the pure and applied mathematics?—and why we should adopt M. Legendre's treatises, or that of any other modern writer, in preference to "*Euclid's Elements*," which have been used, for the most part, as a text-book in the American colleges.

With respect to the first enquiry, it is plain, that an elementary treatise cannot contain all the truths within the compass of elementary geometrical investigation. The properties which belong to the figures of elementary geometry, and the relations which these properties sustain to each other, are innumerable. Some of these properties and relations have never been applied to any practical object, others form links more or less important in a long chain of connected truths, others are truths important in

themselves, independently of their connections, while a multitude of others, without doubt, remain still undiscovered. The general principles with a view to which an elementary treatise of geometry ought to be composed, in the present state of mathematical science, we think, are these: 1st. All those truths should be selected, which admit of extensive applications as well to ordinary practical purposes, as in the higher branches of mathematics. 2d. The demonstrations should unite, as far as possible, the elegance and rigor of the ancient geometers, with a greater degree of conciseness. 3d. The demonstrations should be so constructed as to exclude, as far as possible, propositions merely subsidiary; that is, propositions which are of no practical importance in themselves, but only steps in demonstrating others. 4th. Indirect demonstrations should be avoided, as much as possible. In general, those proofs are the best, which establish the truth proposed upon an immoveable basis, and, at the same time, clearly shew its connection with other truths already known, and render sensible, the transition from a proposition to that which follows it. 5th. The truths demonstrated should be arranged in the most natural order, and well connected with each other. 6th. The synthetic method of demonstration should be employed, as being peculiarly appropriate to elementary geometry. 7th. Great care ought to be used to preserve a uniformity in the style of the demonstrations, and an analogy between the different parts of the treatise. We shall be better understood on this point, by taking an example. Parallelograms upon the same base, and of the same height, are equal. Also, parallelopipeds upon the same base, and of the same height, are equal. The former of these propositions, has the same relation to areas, that the latter has to volumes. On account of the similarity of the propositions, their demonstrations ought to be similar. The preservation of this analogy not only gives elegance to the demonstrations, but much assistance to the memory.

The question, why students in mathematics should use a modern treatise of geometry, in preference to the *Elements* of Euclid, is of far more difficult discussion than the preceding. Euclid's Geometry has come down to us clothed with the authority of the high antiquity of two thousand

years, and in this work he appears to have collected all the elementary truths of the science, which had been discovered at the time in which he lived. It was composed under the patronage of the Ptolemies, and in the school of Alexandria. With respect, however, to the influence which antiquity ought to have upon our opinion of any work of science, we entirely agree with Professor Playfair. "The infancy of science," says he, "could not be the time when its attainments were the highest; and before we suffer ourselves to be guided by the veneration of antiquity, we ought to consider in what real antiquity consists. With regard to the progress of knowledge and improvement, we are more ancient than those who went before us. The human race has now more experience than in the generations that are past, and of course may be expected to have made higher attainments in science and philosophy."* Euclid's Geometry is the only elementary work on the subject, that has come down to us from very remote times. But we do not know how it can be proved, that it was the only work of the kind which existed at that period; much less do we know, how it can be shewn that it was the best. If we had other ancient elements of Geometry, our views of Euclid's might possibly be considerably different.

Notwithstanding what is here said, we profess the highest veneration for the genius of Euclid, and we are perfectly aware of the extent of our obligations to this great father of geometrical science. But while we would be foremost to grant him the full measure of his merit, we are convinced that the admiration bestowed on him, has sometimes been extravagant and absurd. His Elements have been represented as absolutely perfect,—incapable of improvement. Take the following passage as an example: "A geometer who has stood the test of more than two thousand years; who has resisted the attacks of so many critics, and supported the weight of so many commentators; whose writings kept alive the sacred fire of science when it was almost extinguished over the whole earth, and now shine with undiminished lustre amidst the greatest splendor of scientific discovery; such an author is not to be moved by the praise or the censure of modern criticism; his place in the temple of fame is irrevocably fixed, and nothing remains for us

*Diss. on Math. and Phys. Science, p. 50.

but to hail him as one of the immortals.”* As a specimen of rhetoric, this may be very fine, but we are persuaded that its merit ends here. While a multitude of books, which cost their authors much labor and reflection, are daily passing into oblivion, and while the whole volume of nature lies open to our investigation, it is absurd to say that any human work in any age, or in any department of learning, ever has or ever will put a period to the progress of improvement, and arrive at perfection; a state which vanity on the one hand, and enthusiasm on the other, have dreamed of, but which the nature and destiny of human things forbids us to expect ever to attain. Dr. Johnson flattered himself for a while, he says, that his Dictionary, which he had labored many years and with so much application, would fix the English language, and put a stop to those alterations which time and chance had before been suffered to make in it without opposition, but he afterwards found, that he had indulged expectations which neither reason nor experience could justify.†

But to be more particular: we shall endeavor to shew, that Euclid's Elements contain many imperfections which are remedied in those of Legendre and Lacroix; and that their Elements contain much valuable information which will in vain be sought for in those of Euclid. Our remarks, however, will be very brief, as it would be inconsistent with our limits to enter into an extensive view of the subject.

One particular in which the Elements of M. M. Legendre and Lacroix are more valuable than those of Euclid, is, that the latter treats the doctrine of ratios and proportion in B. Vth as a separate branch of geometrical enquiry; while the former make the usual applications of this doctrine to geometrical figures, without considering the demonstrations of its principles as a subject belonging to geometrical investigation. The demonstration of the first principles of the theory of ratios and proportion belongs to arithmetic, and its full developement to elementary algebra. It is because most of us have learned this theory from Euclid, that we are apt to imagine some almost necessary connection between it and geometry. This has been so much the case, that Euclid's authority has been followed by almost all the

*Edinb. Review, Vol. IV. p. 257.

†Preface.

English writers on geometry to the present time, while the French mathematicians have for a long period investigated the principles of ratios and proportion by arithmetical and algebraic methods. Even the Edinburgh Encyclopædists, who have made Legendre's Elements the basis of their article Geometry, have in this part entirely deserted him, and have introduced the theory of ratios and proportion essentially after the manner of Euclid. At the same time, the author of the article referred to, confesses, that "it might with propriety be inserted, rather as a preliminary theory, than as forming a part of geometry.* It was necessity, and not choice, that led Euclid to connect the theory of ratios and proportion with geometry. In his time algebra, to which we have before said that this theory in all its extent belongs, was unknown. When, therefore, Euclid wished to apply proportion to geometrical figures, it was necessary for him to investigate its principles by geometry, as the only means with which he was furnished. Euclid is not in fault for the course which he pursued. He did all that could be done, in the circumstances in which he was placed. But for us, who are in possession of algebraic methods; at once easy and elegant, to pursue the same course, is entirely a different thing. To do so, is not less absurd than it would be to set about determining the obliquity of the ecliptic to the equator by means of the gnomon, when we have the theodolite and repeating circle; or to pursue Aristotle's method of philosophising, when we have so long followed that of the illustrious Bacon, with such splendid success. The theory of proportion as given by Euclid, is extremely tedious, circuitous and difficult to be understood by beginners. The reason of this is, that geometry in its nature is of very little generality, and in its construction is not sufficiently *flexible* to admit of easy application to the subject. But by making use of algebra, which at the same time accommodates itself to the subject with great facility, and is a language vastly more general than geometry, the whole theory of ratios and proportion flows in the most natural and easy manner, from the simplest properties of equations.

Again, the Elements of Euclid contain too many propositions merely subsidiary, and propositions which are of almost no practical utility, and have no connection with the suc-

* Edinb. Encyc. Vol. IX. pp. 658, 669.

ceeding and higher parts of mathematics. The seventh proposition, B. I. difficult for beginners, is given only for the sake of the eighth, and is of no further use whatever. The sixteenth is evidently implied in the thirty-second, and therefore is of no use, except as being subsidiary to the demonstration of others. Propositions forty-fourth and forty-fifth, are not of sufficient use to compensate for the space which they occupy. In B. II. the sixth, eighth, tenth and eleventh propositions, with some others relating to the properties of straight lines variously divided and produced, are very unimportant and tend to discourage beginners by the tediousness and difficulty of their demonstrations. They are omitted by Hutton and other late English writers, as well as by Legendre and Lacroix. Many of the propositions in B. III. are, also, of small practical utility, and are not used in subsequent parts of the science. The demonstrations of many of them are indirect, of some of them, artificial; and the construction of some of the figures, is unnatural and difficult to be conceived. To one or another of these objections, the following propositions are liable; fourth, fifth, sixth, tenth, eleventh, twelfth, thirteenth. The fourth B. contains an incomplete view of that part of the science which it embraces. It ought at least, to comprise an investigation of the approximate ratio of the circumference to the diameter of a circle. Of B. sixth, we have to say only, that M. Legendre and Lacroix have demonstrated the same truths in a more simple and equally rigorous manner, that they have divested them of much technical language which rendered them difficult to be understood, and that they have supplied many propositions of extensive use in the subsequent parts.

Another particular, on account of which we must give the preference to the *Elements* of Legendre and Lacroix, respects the arrangements. It is by a different and more skillful arrangement, that they have contrived to avoid, much more than Euclid has done, subsidiary propositions, indirect demonstrations, and unnatural constructions. Perhaps we may here be expected to furnish the instances, in which their arrangement is superior to that of Euclid. But by way of excusing ourselves from this, we must beg leave to observe, that a question of arrangement is of so extensive a nature, that we could not do justice to our views of the subject, without en-

tering into long discussions and giving numerous details, which must be imperfectly understood without diagrams and without a minute comparison of the arrangement adopted by the writers of whom we are speaking. This is a particular upon which a sound opinion cannot be formed without personal inspection. We think that the conclusion at which we have arrived, and which we have stated at the beginning of this paragraph will be inevitable in the mind of every one who will be at the pains of a comparison somewhat extensive and elaborate. All that we ask of our readers on the point now under consideration, is, that they will not conclude us to be entirely and necessarily wrong, until they have given the subject an attentive examination. "In his judices desidero, qui tractarunt in sua amplitudine.* We trust that this will not be considered an unreasonable claim upon their candor.

On the geometry of solids or volumes, also, the elements of Legendre and Lacroix are very much more complete, than those of Euclid. On this point, it is impossible to convey an adequate idea to those who are not, to a considerable extent, acquainted with the subject. At the time of Euclid, the geometry of solids appears to have been quite imperfectly investigated. It is true, that before this period, the five regular bodies had been studied in the celebrated school of Plato; and Archimedes had made his brilliant discoveries in relation to the properties of the sphere and cylinder. But the properties of Polyedrons in general, and their measure, have not received, until within a short period, the attention which their importance merited; and M. Legendre in particular, has contributed much to the elucidation of the subject. M. Cauchy, also, has done considerable towards the perfection of this part of elementary geometry.

We are now sufficiently prepared to enter with advantage upon an examination of the work before us. The definitions and axioms are laid down very much in the usual style. The latter are nearly the same in substance with those of Euclid, and differ from them principally in the circumstance, that the idea of equality is not drawn out into particulars. They are but five in number. It is evident he does not attempt a complete enumeration of them, a thing which no geometer has accomplished. A straight line is defined to be, "the shortest way from one point to

* Valckenaer ad Herodotum, p. 585.

another," which is better than any other definition of it, since it is of more easy and extensive application than any other. We think the most natural way of giving a general definition of a point, a line, and a surface, is, to contemplate a *surface*, as one of the limits terminating a solid, which has necessarily three dimensions; a *line* as a limit terminating a surface; and a *point*, as a limit terminating a line. These definitions flow naturally from the definition of a *solid*, in defining which there is no difficulty. When these definitions are obtained in this way, and viewed in this light, they have less the nature of abstractions, than when stated in the common way; since the real existence of limits of these different kinds, can no more be called in question, than that of the solid from which they are all ultimately derived.

His definition of an angle, is more happily expressed than usual. "When," says he, "two straight lines meet, the quantity whether greater or less, by which they depart from each other as to their position, is called an angle; the point of meeting or intersection is the vertex of the angle; the lines (comprising the angle) are its sides." Very various definitions of an angle, have been given by geometers. That of Euclid, is certainly faulty. In fact, if we define an angle by the inclination of its lines, the expression is both obscure and pleonastic. If we say that an angle is the meeting of two lines, the expression directs the attention entirely to the vertex. On the whole, we believe it best to understand by the term angle, the indefinite space comprised between two straight lines which meet each other. The celebrated D'Alembert proposed to limit this space by an arc of a circle described from the vertex as a centre with any convenient radius, but this is introducing a foreign idea into the definition. The space in question, is perfectly distinguished from all other space. The definition suggested above, comprises all the properties usually ascribed to an angle, such as addition, subtraction, coincidence by super-position, &c. But besides this, the additional valuable circumstance included in the idea of an angle, that it comprises the space included within its sides, prevents the awkwardness and tedious circumlocution, with which every one must have felt the geometry of planes and solids to be invested. This is a point, in which we think Lacroix has the advantage over Legendre. Euclid has

sometimes used the word angle in the sense above defined. (B. XI, 20, 21, 22, &c.) and if any one will make the experiment he will find it more natural to attach that idea to it in all cases. If it is objected, that the space which we include in the idea of an angle is indefinite in extent, we answer, so are the sides of the angle of indefinite length according to the common definition. If the indefinite space be an objection in the one case, so are the indefinite sides in the other. But the fact is, that the circumstance of the sides and space comprised being indefinite, has no connexion with any of the properties of an angle, nor with any investigations in which angles are employed.

The elements of Legendre are divided in the original into eight books, four of which treat of plane, and four of solid geometry. These books are changed into sections by the translator, and the principles are numbered from beginning to end, for the sake of more convenient reference. The first section contains the properties of straight lines which meet, those of perpendiculars, the theorem upon the sum of the angles of a triangle, the theory of parallel lines, &c. and corresponds nearly with B. I. of Euclid. The doctrine of parallel lines has long been considered as presenting one of the greatest difficulties which belong to elementary geometry. Euclid treated the subject, by introducing as an axiom, what is more justly considered a proposition. Later writers have uniformly experienced the same difficulty, and some of them have fallen on strange means of passing over it. "*Bezout est dissimulé le vice du raisonnement,*" says Lacroix.* Some writers have transposed and shifted the difficulty, until they have obscured it under long and intricate reasonings. Such a course, we deem entirely inconsistent with the duty of an elementary writer, which is to give peculiarly clear and exact ideas upon every subject which he undertakes to elucidate. We do not think that Legendre himself has shed any new light on this subject; though his management of it, exhibits the immense vigour and grasp of his mind. The eleventh edition of his Elements is different, in this respect, from the preceding editions. He says in the preface, "*d'après l'avis de plusieurs professeurs distingués, on s'est déterminé à rétablir, dans cette onzième édition, la théorie des*

* Géométrie, p. 23.

paralleles à-peu-près sur la même base qu'Euclide. Il en résultera plus de facilité pour les étudiants, et cette raison a paru prépondérante, d'autant que les objections auxquelles est encore sujette la théorie des paralleles, ne peuvent être entièrement résolues que par des considerations analytiques, telles que celles qui sont exposées dans la note deuxieme. If he had adopted more nearly still the course pursued by Euclid, he would have treated the subject more to our satisfaction. In truth, Euclid's method, we think, admits of but little improvement. Legendre has given in the text a mere graphical proof of the principle involving the difficulty; while in note II, he has connected with, and applied to, this graphical proof, a rigorous demonstration without assuming any new axiom. The demonstration, however, is entirely analytical, and the reasoning will not readily be followed by those who have not considerable acquaintance with the theory of equations and functions.

There is no writer with whom we are acquainted, that has treated the doctrine of parallel lines with so much address, and in so unexceptionable a manner as Lacroix. His method is not much different from that of Euclid, and differs from it principally in the circumstance, that it presents the difficulty *reduced to its least dimensions*. The proposition in which this difficulty is so reduced, is this; a straight line which is perpendicular to another straight line, is met by all those which are oblique to this other; consequently, upon a plane, there are none but straight lines perpendicular to the same straight line, which do not meet, that is, which are parallel to each other. The imperfection of the theory of parallel lines consists in the difficulty of proving this principle. Lacroix, making use of that definition of an angle to which we gave the preference, has given a demonstration of it taken from Bertrand,* which is short, free from obscurity, and perfectly satisfactory. After all that has been said, we have long been of the opinion, that the difficulty respecting parallel lines, is in a great measure, imaginary. The method by which Lacroix has disposed of the difficulty is much to be preferred to that of any other writer, yet we never examined the subject as treated by any author, when, we think, any one

*Developpement nouveau de la partie élémentaire des Mathématiques, Genève, 1778, 2 vols. 4to.

could, for a moment have doubted, whether the conclusions were established with complete certainty by the evidence adduced. Those who have objected most to the theory of parallel lines, as usually laid down, belong to that class of mathematicians who insist upon a rigour of demonstration not accommodated to the imperfections attending all human things, and which aiming at an imaginary perfection, is very unreasonably dissatisfied with evidence which establishes its results with perfect certainty. The theorems that we possess respecting the properties of parallel lines, we regard as undeniably certain; any difficulties, therefore, relating to the manner in which they are demonstrated, we cannot but consider essentially imaginary.

The second section, comprises the elementary properties of the circle, together with those of chords, of tangents and the measure of angles by arcs of a circle. This section contains all the principles which are of importance in B.III. of Euclid, and some others both of great use in ordinary practice, and in the succeeding parts of the science. These two sections are followed by the resolution of a number of problems relating to the construction of figures.

The third section contains the measure of surfaces, their comparison, the properties of a right angled triangle, those of equiangular triangles, of similar figures, &c. In this section, he has blended the properties of lines with those of surfaces, but in this arrangement, he has followed the example of Euclid, and the propositions in this way, admit of being so well connected, that we doubt whether a better arrangement can be obtained. In giving the definitions which relate to this section, he says, "I shall call those figures *equivalent*, whose surfaces are equal. Two figures may be equivalent, however dissimilar; thus a circle may be equivalent to a square, a triangle to a rectangle, &c. The denomination of *equal* figures will be restricted to those which being applied, the one to the other, coincide entirely; thus two circles having the same radius are equal, and two triangles having the three sides of the one equal to the three sides of the other, each to each, are also equal." In the use of these definitions, he is followed by Lacroix. We are persuaded that a distinction between equality by *equivalence*, and equality by *coincidence*, is expedient as a matter of convenience, and as a means of enlarging our

power of expressing the properties and relations of figures. According to Legendre's plan, the meaning of the term *equal*, is unnatural. We should have preferred to apply the term *coincident* to those figures which are proved to be *equal* by superposition, and to have designated by the term *equivalent*, all the remaining part of the common signification of the word *equal*. Coincident and equivalent figures are both equal, but these terms designate different kinds of equality, and, we think, the introduction of them would contribute to the perfection of the language of geometry. Equality by coincidence alone, is comprised in the sixth of his axioms, in which he says, "two magnitudes, whether they be lines, surfaces or solids, are equal when being applied the one to the other, they coincide with each other entirely, that is, when they exactly fill the same space." This section is concluded, by demonstrating, that the diagonal and side of a square, are incommensurable quantities, and by an investigation of the approximate ratio of the one to the other. It is remarkable what could have led Plato,* to attach such an importance to this principle, as to regard as unworthy the name of man, him who was ignorant of it. It is demonstrated in prop. CXVII. B. X. of Euclid, and in several modern treatises of geometry. It is of no great importance, either when viewed by itself, or in connexion with other truths.

The fourth section treats of regular polygons and the measure of the circle. It is well known, that the problem of finding a square equal in surface to a circle whose radius is given, or as it is usually termed, the problem of the quadrature of the circle, is much celebrated in the history of geometry, and has very much occupied the attention of mathematicians. Now we can easily demonstrate, that a circle is equivalent to a rectangle contained by the circumference and half the radius, and by finding a mean proportional between the circumference and half the radius, we have the side of the square. The problem of the quadrature of the circle, is, therefore, reduced to finding the circumference when the radius is given, and to effect this object, it would be sufficient to know the ratio of the circumference to the diameter, or to the radius. Mathematicians have not been able to obtain this ratio but by approxima-

* Laws, B. VII.

tion, though it has exhausted all the resources of human skill and invention, and it strongly reminds us, that imperfection is attached even to the most certain and most perfect of the sciences. The approximation of this ratio, has, however, been carried so far, that if it were exactly known, it would have no practical advantage over the approximate ratio. It would now be considered absurd, to spend much time in attempting to square the circle.

Archimedes obtained the ratio of $\frac{22}{7}$, which is sufficiently near for common purposes, and has been much used. Metius gave a much more exact value of this ratio in the expression $\frac{355}{113}$. Other mathematicians have found the value of the circumference, when the diameter is unity, 3,141592653 &c. Euler gives an approximation of this ratio which extends to 127 decimal places,* and this number has been extended even to 140 places. The roots of imperfect powers are not known with greater exactness, than this ratio.

Legendre has not given the ratio, that has lately been discovered by the English in their researches into the learning of the Eastern Indians, but we think it ought to have a place, both on account of its exactness and its remarkable origin. This ratio, which is $\frac{355}{113}$, is contained in a work of the Brachmans entitled *Ayeen Akbery*, and is not only much more approximate, but also is regarded by them as more ancient than that of Archimedes. It is, doubtless, to be regarded as a part of the immense wreck of ancient learning which is scattered all over India. In that interesting country, "we every where find methods of calculation without the principles on which they are founded; rules blindly followed without being understood; phenomena without their explanation; and elements carefully determined, while others more important, and equally obvious, are altogether unknown."† The Indian ratio corresponds to 3.1416, and must have depended on a polygon of 768 sides, whereas that of Archimedes depends upon one of 96 sides.

Two lemmas are given as the basis of the investigation of the measure of the circle, which is otherwise conducted after the manner of Archimedes. Two methods of approximation are there given for its quadrature. An appendix

* Introduction à l'analyse infinitésimale, Tome I. p. 92.

† Edinb. Encyc. Vol. II. p. 550.

is attached to this section, in which a few of the elementary properties of isoperimetrical figures are demonstrated. Among the rest, it is shewn, that among polygons of the same perimeter and of the same number of sides, that is a maximum which has its sides equal; that of all triangles formed with two given sides making any angle at pleasure with each other, the *maximum* is that in which the two given sides make a right angle; that among polygons of the same perimeter and the same number of sides, the regular polygon is a *maximum*; and that the circle is greater than any polygon of the same perimeter. This is a very beautiful, interesting and useful addition to elementary geometry.

Until a short time since, it was supposed, that no regular polygons, except those treated of B. IV. of Euclid, and the several series depending on them, could be inscribed in, or circumscribed about, a circle by geometrical means. The difficulty, however, which had arrested the progress of this part of geometry ever since the time of Euclid, has at length been surmounted by M. Gauss, a Professor at the university of Gottingen, and one of the greatest mathematicians of the present time. The work containing the original demonstration is entitled, "*Disquisitiones Arithmeticae, Lipsiæ*, 1801," and a French translation of it was published by M. Delisle at Paris in 1807. In this demonstration, it is shown, that the circumference of a circle may be divided into a number of equal parts designated by the formula $2^n + 1$, when this is a prime number. Some of the numbers resulting from this formula are 17, 257, 65537, &c. The circumstance that M. Gauss' invention is limited to the cases where the formula $2^n + 1$ designates a prime number, greatly diminishes its value. No demonstration of this principle has, we believe, found its way into any elementary treatise of geometry, and we are not sure, that it is capable of a strictly geometrical elementary demonstration.

The first section of part II. contains the properties of planes and solid angles. This part is intimately connected with the demonstrations of the properties of solids, and figures in which different planes are considered. A complete understanding of it is indispensable, also, in descriptive geometry, where the principal difficulty consists in

conceiving clearly the situation of the various planes used, and their projections. The subject is treated in a clear and rigorous style.

The second section of part II. treats of polyedrons and of their measure. We have before suggested, that we feel ourselves unable to convey an adequate view of the merit of this part of Legendre's work. Those who are only acquainted with the geometry of solids or volumes as given by the older writers, we are sure, will be surprised and delighted at the luminous and novel manner, in which this part of elementary geometry is exhibited. On volumes he has made a distinction between two different kinds of equality analogous to that which we before noticed with respect to the comparison of surfaces. "Two solids, two solid angles, two spherical triangles, or two spherical polygons, may be equal in all their constituent parts without coinciding when applied. It does not appear that this observation has been made in elementary books; and for want of having regard to it, certain demonstrations founded upon the coincidence of figures, are not exact. Such are the demonstrations, by which several authors pretend to prove the equality of spherical triangles, in the same cases and in the same manner, as they do that of plane triangles. We are furnished with a striking example of this by Robert Simson, who, in attacking the demonstration of Euclid, B. XI. prop. 28, fell himself into the error of founding his demonstration upon a coincidence which does not exist. We have thought it proper, therefore, to give a particular name to this kind of equality, which does not admit of coincidence; we have called it *equality by symmetry*; and the figures which are thus related, we call *symmetrical figures*."* We think, as in the case of surfaces, that the defects in the usual language would have been better supplied by calling those figures which would coincide, *coincident figures*, that is, figures equal by coincidence; and those figures which will not coincide, *symmetrical figures*, that is, figures equal by symmetry.

In the propositions relating to polyedrons, as well as in those relating to polygons and solid angles, those having re-entering angles are excluded as not belonging to the ele-

* Trans. Note 1. p. 202.

ments of the science. The author has very properly confined himself to the consideration of convex lines and surfaces, which are such, that they cannot be met by a straight line in more than two points. He has completely reformed the ordinary definition of similar solid polyedrons, though he has followed that of similar rectilineal figures containing, as it does, three superfluous conditions.

In the latter part of the note just referred to, Legendre says, "the angle formed by the meeting of two planes, and the solid angle formed by the meeting of several planes in the same point, are distinct kinds of magnitudes to which it would be well perhaps to give particular names. Without this, it is difficult to avoid obscurity and circumlocutions in speaking of the arrangement of planes which compose the surface of a polyedron; and as the theory of solids has been little cultivated hitherto, there is less inconvenience in introducing new expressions, where they are required by the nature of the subject." According to the suggestion here made, M. Lacroix has introduced into the geometry of planes and volumes, a very convenient system of new expressions, and some slight alterations in the notation, by which much circumlocution is avoided, and our power of expression much enlarged. The translator has adopted one of these changes in the notation, which consists merely in placing the letter designating the vertex of the polyedron first, with a hyphen between it, and the other letters. This very trifling change, contributes considerably to the facility of following the demonstrations. Lacroix's improvements in general, could not be conveniently adopted by the translator.

The third section of part II. relates to the sphere and spherical triangles. This is an important addition to the elements of geometry, as it is not of difficult demonstration, and is of extensive utility in its applications to geography, &c. as well as in the succeeding parts of mathematics. It is designed in particular to be introductory to spherical trigonometry.

The fourth section of this part, is employed in investigating the properties and relations of the sphere, cone, and cylinder. The general method of demonstration in this section, is that of Maurolycus, a Sicilian geometer, who flourished in the middle of the 16th century. This meth-

od is indicated in Euclid B. XII. prop. 16th. It consists in assuming two concentric circumferences, and circumscribing about the smaller a regular polygon which does not touch the greater; or inscribing a regular polygon in the greater, which does not touch the smaller. On these polygons, as bases, in case circumstances require it, regular polyedrons are supposed to be constructed, and it is demonstrated, that the assigned measure of the solid or surface in question, cannot be that of one greater or less, without falling into the absurdity of concluding that a figure contained by another is the greater of the two. These demonstrations are long, and on account of the frequent repetition of the same constructions, become somewhat tedious. But they have the merit of being plain, and satisfactory, although indirect; and we think, on the whole, that the method pursued by Legendre is the best. Lacroix's manner as it respects these demonstrations, is much more concise, but it is too abstract, and difficult to be seized; and Cavalleri's method of indivisibles is not sufficiently rigorous to be used in elementary geometry.

After what has been said, it is scarcely necessary to observe, that American mathematical science, is under great obligations to the translator, for giving Legendre's elements in so handsome an English dress. The only fault we have to charge him with, is, that he did not furnish us with the entire work, as it came from the hands of the author. Considerable of that part which in the original is printed in fine type, and almost all the notes, are omitted in the translation. These omissions we very much regret. By preserving the original difference in type, the work would have been equally convenient for academical instruction, and the additional expense of printing the parts omitted, would have been quite trifling. As it now is, we are persuaded, that all lovers of mathematical learning, after having perused the translation, will feel induced to go to the expense of sending out for the original, for the sake of those parts, which the translation does not contain. The notes are a great curiosity, and would be likely to inspire a taste for the higher mathematics.

The translation is executed faithfully, and it is accurately printed. A list of errata, however, to some extent might be made out, though none is given. In the demon-

stration of No. 283, the phrase *at least* is used, where there should be *at most*, and vice versâ. We would suggest whether the reasoning of No. 283 is satisfactory; and whether it would not be better to deduce the lemma immediately, from the definition of a straight line. Such a line being the shortest distance between two points, any line connecting these two points and varying from the straight line, is greater than it; and the more any line always remaining convex, varies from the straight line between its extreme points, the greater is such line. The Edinburgh Encyclopædists have laid down an axiom nearly equivalent to the lemma under discussion.

PHYSICS, CHEMISTRY, MECHANICS, AND THE ARTS.

ART. XI.—*Remarks concerning the composition and properties of the Greek fire*; by JAMES CUTBUSH, A. S. U. S. A. and Acting Professor of Chemistry and Mineralogy in the U. S. Military Academy.

HAVING been engaged for some time in collecting facts, both ancient and modern, in relation to pyrotechny, with the view of forming a complete system on that subject; I necessarily examined all the writings extant on the Greek fire, and other incendiary preparations. Although nothing fully satisfactory, as to the *real* composition of the *original* Greek fire, can be stated, yet we are assured from various authorities, that the principal ingredient was naphtha, which with other substances, (camphor appears to have been one,) in consequence of its great inflammability produced the extraordinary effects recorded in history.

The Greek fire was invented by Callinicus of Heliopolis, a town in Syria, who used it with so much skill and effect during a naval engagement, that he destroyed a whole fleet of the enemy, in which were embarked 30,000 men.*

* The *Nouveau Dictionnaire Historique* par L. M. Chaudon et F. A. Delandine, article *Callinicus*, speaks of him thus: "Callinique, d' Héliopolis en Syrie, auteur de la découverte du *Feu grecque*. L' empereur Constantin

It appears that in the reign of Louis XV, a chemist of Grenoble; *Dupré de Mayen*, discovered a composition similar in effect to the Greek fire of Callinicus, which was exhibited at Brest, and proved successful, but the preparation was kept secret. The original Greek fire was used in 1291, and also in 1679, besides the periods hereinafter mentioned. Writers have defined it to be a sort of artificial fire, which insinuates itself beneath the surface of the sea, and which burns with increased violence when it mixes with water. They also say, that its *directions* are contrary to the course of natural fire, for the flames spread downward, to the right or left, agreeably to the movement which is given. That it was a liquid composition, we may infer from the modes of using it, which were several. It was employed chiefly on board of ships, and thrown on the vessels of the enemy by large engines. It was sometimes kindled in particular vessels, which might be called fire ships, and which were introduced among a hostile fleet; sometimes it was put into jars, and other vessels, and thrown at the enemy by means of projectile machines, and sometimes it was *squirted* by soldiers from hand engines, or, as it appears, blown through pipes. This fire was also discharged from the *fore part of ships* by a machine constructed of copper and iron, the extremity of which is said to have resembled the *open mouth* and *jaws* of a lion, or other animal. They were painted, and even gilded, and were capable of projecting the liquid fire to a great distance.

In the *History of Inventions and Discoveries* by J. Beckman, public professor of Economics in the University of Gottingen, I find the professor has examined the subject of Greek fire. He observes expressly, (Vol. IV. p. 85.) that the *machines* which the ancients employed to throw this fire, were *spouting engines*, and remarks, that "John Cameniata, speaking of his native city, Thessalonica, which was taken by the Saracens in the year 904, says, that the enemy threw fire into the wooden works of the besieged, which was blown into them by means of tubes, and thrown from other

Porphyrogenitus s'en servit pour bruler la flotte des Sarrasins. L'eau qui éteint le feu ordinaire, n'avait aucun empire sur ce nouveau fléau du genre humain. Cet ingrédient qu'on appeloit aussi l'*huile incendiaire*, le *feu marin*, le *feu liquide*, devoit, dit-on, le fer and les pierres, suivoit toutes les directions qu'on vouloit lui donner, and ne pouvoit être éteint qu'avec du vinaigre, du sable ou de l'urine," &c. *Callinique* vivait vers l'an 670 de Jésus-Christ."

vessels. This passage, which I do not find quoted in any of the works that treat of the Greek fire, proves that the Greeks, in the beginning of the tenth century, were no longer the only people acquainted with the art of preparing this fire, *the precursor of our gunpowder*. The emperor Leo, who about the same period wrote his *Art of War*, recommends such engines, with a metal covering, to be constructed in the fore parts of ships, and he twice afterwards mentions engines for throwing out Greek fire. In the east, one may easily have conceived the idea of loading some kind of pump with the Greek fire; as the use of a forcing pump for extinguishing fires was long known there before the invention of Calliniscus."

Writers differ considerably as to the composition of the Greek fire, properly so called, as there were many preparations some hundred years after the discovery, which went under that name. It is certain, however, that the Greeks had a knowledge of a very highly combustible preparation, which water could not extinguish, and which from its nature, (reasoning *a priori*,) must have had the property of decomposing water itself; thereby furnishing a *supporter* of combustion, or possessing so much oxygen as to support the combustion of the inflammable substances even in contact with water. Either one or other of these conclusions appears reasonable, if we admit that the composition actually burnt *under water*. Some writers are of opinion, that nitrate of potash was one of the ingredients; but of this we have no positive proof. Mr. Parkes (*Chem. Catech.* p. 465) speaking of some of the uses of saltpetre, remarks, that "it was used by the ancients in that destructive composition of antiquity, the Greek fire. Sulphur, resin, camphor, and other combustibles, were melted with it, and in this melted mass woollen cords were dipped, which were afterwards rolled up for use. These balls being set on fire were thrown into the tents, &c. of the enemy; and as the combustibles were furnished with a constant supply of *oxygen* from the nitre, nothing could extinguish them." He also observes: "For many centuries the method of making this dreadful article of destruction was lost; but it has just been discovered by the librarian of the elector of Bavaria, who has found a very old latin manuscript which contains directions for preparing it." Mr. Parkes is certainly in error when he says that the origin-

al Greek fire, if to such he alludes, was altogether used in balls; he may probably have inferred so from the manner in which our modern war incendiaries are prepared and used, such as the light-ball, various carcasses, &c. some of which are thrown by hand, and some from mortars and howitzes. The compositions used in modern pyrotechny for the purpose of firing buildings and the like, are remarkably inflammable, and from the manner in which they are prepared are almost inextinguishable; all which appear to have originated from the heretofore celebrated *fire rain* of Liemanwick. Even the so called *incendiary rocket* of Congreve, which is nothing more than an ordinary rocket having a sheet iron case, is *loaded* in the head with a similar composition; in fact that, and other descriptions of the Congreve rocket, I can clearly shew was not an original invention of Colonel Congreve. On the subject of incendiary and other military fire works, the French have certainly laid the foundation, for the very preparations now used by the British, for the formulæ for such preparations may be traced to the French service.

It appears, however, that the Greek fire could be extinguished only by urine, sand, &c. The following extract from James's *Military Dictionary* p. 329 is to this point: "It is composed or made up of naphtha, sulphur, bitumen, gum, and pitch; and it can be extinguished only by vinegar mixed with urine and sand, or undressed leather and green hides.

Respecting a similar composition to that of the Greek fire, or one which seems to partake of the same properties, I find the author of a French work, entitled *Oeuvre Militaire*, has given the following preparation, which it is said cannot be extinguished by water: Pitch, rosin, tallow, camphor, turpentine, salt-petre, liquid varnish, oil of sulphur (not sulphuric acid) linseed oil, rock oil, flax, and charcoal finely pulverised. After melting the solid substances, as pitch, &c. with the oils and varnish, the charcoal and flax are added, and the composition made into balls, previously mixing with it before it grows cold, some quicklime in powder. This preparation we are told, is susceptible of the most subtle and destructive fire. It is hardly necessary to remark, that a composition of this kind must be highly inflammable, and, with the addition of nitre, burn with great rapidity.

The *fire stone* of the French, an incendiary preparation, is in some respects analogous; it is used either in bombs along with powder, or made into carcasses in the usual manner. The Moors were in possession of the secret for preparing the Greek fire in 1432, according to the testimony of Brocquire. Bertrandon de la Brocquire was in Palestine in 1432 as counsellor to the duke of Burgundy. He was present at Barrat during one of the Moorish celebrations: "It began," he remarks, "in the evening at sunset. Numerous companies scattered here and there were singing, and uttering loud cries. While this was passing, the *cannon* of the castle were fired, and the people of the town launched into the air, '*bein haut et bein loin, une maniere de feu plus gros fallot que je veisse oncques allume.*' They told me they made use of such at sea, to set fire to the sails of an enemy's vessel. It seems to me that it is a thing easy to be made, and at a little expense, it may be equally well employed to burn a camp or a thatched village, or in an engagement with cavalry to frighten their horses. Curious to know its composition. I sent the servant of my host to the person who made this fire, and requested him to teach me his method. He returned for answer, that he dared not, for that he should run great danger were it known; but there is nothing a man will not do for money, I offered him a ducat, which quieted his fears, and he taught me all he knew, and even gave me the *moulds* in wood, with the other ingredients, which I have brought to France."

Although La Brocquire may have brought the secret to Europe, yet it does not appear to have been used, nor has it been promulgated. We may infer here, that as moulds were used, it is very probable that the solid ingredients were first melted together, and cast in moulds previously to their solution in some inflammable oil, which in all probability was *naptha*; or that the composition was used in a solid state, as in some of the modern incendiary fire works. But the former inference is more probable.

Whatever idea we may entertain of the effect of the Greek fire, or of compositions having a similar character, we may justly conclude, that the present gun powder possesses many superior advantages; and in fact some authors are of opinion, among whom we may mention the celebrated French Pyrotechenist, Ruggeri, that the accounts we have

of it, such as its fire *descending*, &c. are incompatible with the nature of things, and consequently exaggerated.

We have some remarks of professor Beckman in relation to salt petre, which have also a bearing on the subject of the Greek fire. Speaking of salt-petre, Vol. II, p. 462 he says : Though it can be certainly proved, that the *nitrum* of the ancients was alkaline salt, it is difficult to determine the time when our salt-petre was discovered or made known. As many have conjectured, that it was a component part of the Greek fire, invented about 678, which, in all probability, gave rise to the invention of gun powder. I examined the prescriptions for the preparation of it. The oldest, and perhaps the most certain, is that given by the princess Anna Commena ; in which I find, only resin, sulphur and oil, *but not salt-petre*. K'lingerstein (*Dissertat. de igne Græca*,) therefore, judges very properly, that all recipes in which salt-petre occurs are either forged or of modern invention. Of this kind are those which Scaliger, at least according to his own account, found in Arabic works, in which mention is made of *oleum de nitro* and *sal petræ*. But it does not occur in that prescription of Marcus Græcus, and copied by Albertus Magnus, who died in 1290." Beckman infers, that the first certain mention of salt petre is in the oldest account of the preparation of gun powder, which became known in the 13th century, about the same time that the Greek fire, of which there were many kinds, began to be lost. The work of Albertus Magnus, and the writings of Roger Bacon, who died in 1278, contain the oldest information on gunpowder. But it is somewhat remarkable, that the manuscript preserved in the electoral library at Munich, announced for publication by Mr. Von Arretin, contained, it is said, the true recipe for making the Greek fire and the oldest for gun powder. The same writing, it also appears, was printed from two manuscripts in the library at Paris ; for Professor Beckman observes, that a copy was transmitted to the library at Gottingen by M. Laporte Dutheil, *conservateur des manuscrits de la bibliotheque*.* He also adds, that it contains many recipes, with a few variations, as in Alber-

* *Liber ignium ad comburendas hostes, auctore Marco Græco ; on traite des feux propres à détruire les ennemis, composé par Marcus le Grec. Publié d'après deux manuscrits de la bibliotheque nationale. Paris 1804, three sheets in quarto.*

tus Magnus; that Bacon employed this writing, which was mentioned by Jebb in the preface to his edition, from a copy preserved in the library of Dr. Mead; that of *this* Marcus Græcus nothing at present is known, except that according to some he lived in the ninth, and according to others in the thirteenth century; and that Cardan in giving directions for making a fire which can be *kindled by water*, mentions Marcus Gracchus, but not Græcus. It may be sufficient here to remark, that professor Beckman, after examining attentively all authors on the subject, is inclined to accede to the opinion, that gun powder was invented in India, and brought by the Saracens from Africa to the Europeans. A knowledge of gun powder may have been brought into Europe at the time of the crusades. It was employed in 690 at the battle near Mecca. In 1798 M. Langles read a paper in the French National Institute, in which he endeavoured to prove that the Arabians obtained a knowledge of gun powder from the Indians, who had been acquainted with it in the earliest periods. The use of it was forbidden in their sacred books.

Whatever notice has been taken of the Greek fire, in the manuscript alluded to, whether it really gave rise to our present gun-power, or whether a knowledge of gun-powder came indirectly from India to Europe; it is very probable that it *may* have lead to enquiries, which finally eventuated in the knowledge and use of gun-powder. Besides the opinions already given respecting the composition of the Greek fire, we might enumerate many other authorities. Porta, for instance, in his *Magie Naturale*, remarks that it was composed of the charcoal of willow, salt, burnt brandy, sulphur, pitch, frankincense, flax and camphor, and that *camphor alone has the effect of burning in water*. He remarks also, that when Constantinople was attacked, the emperor Leo burnt the vessels or boats, to the number of one thousand eight hundred, by means of the Greek fire. The *Journal des Savans*, 1676, p. 148, speaks of the origin and use of the same fire. In 1249, at the siege of Damietta, the French experienced the destructive effects of it. The *Journal des Savans* for 1666, mentions a machine which, when applied against a vessel, communicates fire to it immediately, without injuring the person who uses it. In the French Gazettes for 1797, M. Chevalier announced that he had

invented an inextinguishable incendiary fuse, which is thrown by fire arms, and calculated to set fire to the rigging of ships. It appears also, that Dr. Dupre, whose name we have mentioned, published in the French Journals that he had invented a composition, which had the same properties and effects as the ancient Greek fire, and possessed the means of extinguishing it. An experiment was made at Versailles, to the satisfaction of all, and the secret was purchased by Louis XV. The Rev. J. P. Caste in 1794 laid before the French National Convention, a new invention for the purpose of war, consisting of a *carcass-composition*, which nothing could extinguish, and resembled in that respect the Greek fire.

At the commencement of the late war with Great Britain, several persons directed their attention to the discovery of some new incendiary preparation, which would possess the properties of Greek fire; but none of them proved successful. Of one in particular I was an eye-witness. A preparation of the kind was shown to the corporation of Philadelphia, of which I was then a member, and some experiments made with it. It was nothing more than spirits of turpentine, holding in solution camphor, and mixed I think with turpentine varnish; it was, when used, to be put into bottles, and by means of a fuse similar to that of a grenade, set on fire—the bottle being thrown by the hand into an enemy's ship or among sails or rigging.

Ruggeri, a modern French author, in speaking of incendiary fireworks, mentions also the Greek fire. He observes that it was composed of naphtha, sulphur, bitumen, camphor and petroleum, all mixed together; that it was invented by Calliconicus, and employed against the Saracens as an incendiary; that Pliny in his time mentioned a combustible substance, which was thrown upon armed men, and burnt and destroyed them in the midst of the battle; that it was employed successfully by the successors of Constantine, and that its composition was kept a state secret; that the Turks used it, or a composition of a similar nature, at the siege of Damietta in 1249, forty-five years after the death of Roger Bacon; and that when the composition and effects of gunpowder became known, it was no longer in use, and the secret of the *original* preparation seemed to have been lost.

Several historical writers have noticed the Greek fire, among whom Gibbon, and our learned and much to be lamented RAMSAY, may be cited. Gibbon, in his *History of the Decline and Fall of the Roman Empire*, Vol. vii. p. 282. remarks, that the deliverance of Constantinople may be chiefly ascribed to the Greek fire. It appears that Callinicus, the inventor, deserted from the service of the Caliph to that of the Emperor; and Gibbon is of opinion that this discovery or improvement of the military art, was fortunately reserved for the distressful period, when the degenerate Romans of the east were incapable of contending with the warlike enthusiasm and youthful vigor of the Saracens. He is also of opinion that little or no credit can be given to the Byzantine accounts, as to the composition of the fire, although from their obscure and fallacious hints, it should seem that the principal ingredient was naptha, a *liquid bitumen which springs from the earth*.* This was mixed with sulphur, and with the pitch extracted from the evergreen firs, according to the testimony of Anna Commena, (Alexid. I. xiii. p. 383,) and Leo, in the nineteenth chapter of his *Tactics*, speaks of the new invention. Gibbon describes the effect of the Greek fire nearly similar to that we have already stated; viz. that the fire was strong and obstinate, and was *quickened* by water—that sand, urine and vinegar were the only substances that could damp its fury; that it was used for the annoyance of the enemy both by sea and land, in battles or in sieges, and was either *poured* from the ramparts in large boilers, or launched into red hot balls of stone or iron, or darted in arrows and javelins, twisted round with flax and tow, which had deeply imbibed the *inflammable oil*; that at other times it was deposited in fire-ships, or blown through long tubes of copper, fixed on a prow of a galley; that its composition was kept secret at Constantinople, pretending that the knowledge of it came from an angel to the first and

*In a note to Gibbon, p. 283, we read—"The naptha, the *oleum incendiarum* of the history of Jerusalem (*Gest. Dei per Francos*, p. 1167.) the oriental fountain of James de Vitry, is introduced on slight evidence, and strong probability. The name by which Cinnamus calls the Greek fire, corresponds with the locality where naptha was found, between the Tigris and the Caspian sea. Pliny (*Hist. Natur.* ii. 109.) says it was subservient to the revenge of Medea, and according to the etymology, naptha was signified; a fact which leaves no doubt that naptha was the *principal* ingredient of the Greek fire.

greatest of the Constantines, with a sacred injunction not to divulge it under any pretext, &c. He also remarks, that after it was kept secret above four hundred years, and to the end of the 11th century, it was stolen by the Mahometans, who employed it against the crusaders. A knight it appears, who despised the swords and lances of the Saracens, relates, with heartfelt sincerity his own fears, at the sight and sound of the mischievous engine that discharged a torrent of the Greek fire, the *feu gregeois*, as it is styled by the more early of the French writers. "It came flying through the air," says Gibbon, quoting Joinville, (*Historie de St. Louis*,) "like a winged long-tailed dragon, about the thickness of a hog'shead, with a report of thunder, and the velocity of lightning; and the darkness of the night was dispelled by this deadly illumination. The use of the Greek, or as it might now be called the Saracen fire, was continued to the middle of the fourteenth century, when the scientific or casual compound of nitre, sulphur and charcoal, effected a new revolution in the art of war, and the history of mankind."

DR. RAMSEY, our learned historian, (*Universal History*, vol. ii. p. 150,) gives a similar account; and Morse, in his *Universal Geography*, p. 558, after speaking of the Naptha springs of Persia, remarks that, when it is scattered on the sea and inflamed, the flame is often wasted to a great distance.

Thevenot (*Travels in the Levant*) tells us, that in the 52d year of the Hegira, (A. D. 672) Constantinople was besieged in the reign of Constantine Prognatus, by Yesid, the son of Moaur, the first caliph of the family of the Ommiades, when the Greek emperor found himself so pressed, that he was almost reduced to despair. But the famous engineer Callinicus invented a kind of *wild fire*, which would burn under water, and by this means destroyed the whole fleet. The fact that the incendiary preparation of Callinicus was extremely destructive, and spread dismay among the enemy, is therefore warranted by the historical accounts we have mentioned.

Pinkerton in his *Petralogy*, vol. ii. p. 148, speaking of the Naptha of Baku, which exists on the western side of the Caspian sea, concludes that this substance was brought to Constantinople, where it formed the chief ingredient of the

noted composition called the Grecian fire; which, burning with increased intensity under water, became a most formidable instrument against an inimical fleet. The Naptha springs were visited by Hanway, who has given a detailed account of them: also by Kempfer, and Gmelin. Hanway observes, that the quantity is so great, that the Persians load it in bulk in their wretched vessels, so that sometimes the sea is covered with it for leagues together; and that when the weather is thick and hazy, the springs boil up the higher, and the naptha often takes fire on the surface of the earth, and runs in a flame into the sea in great quantities, to a distance almost incredible.

Besides the former use of naptha for the preparation of the Greek fire, the ancients, especially the Magi performed various tricks, or deceptions with it, principally on account of its extreme inflammability. Some of these deceptions are recorded in history. According to Plutarch, the great inflammability of naptha was exhibited to Alexander the Great at Ecbatana, with which he was astonished and delighted, and the same author, as well as Pliny and Galen in particular, asserts that it was with naptha, that Medea destroyed Creusa, the daughter of Creon. She sent to this princess a dress, previously soaked in it, which burst into flames as she approached the fire of the altar. It is supposed to have been naptha also, in which the dress of Hercules was dipped, and not the blood of Nessus, that took fire in the same manner. When offerings caught fire imperceptibly, it is conjectured that this oil must have been employed.

From the facts thus given we may conclude, 1st. That the Greek fire, so called, was composed for the principal part of naptha; 2d. That the naptha, as it is a powerful solvent of rezins, must have been combined either with liquid turpentine, or rozin, and probably with camphor, as inflamed camphor resists considerably the action of water; 3d. That the composition of the original Greek fire was fluid, as it was thrown out by forcing pumps, or through pipes which could not have been the case had it been solid; 4th. That although generally used in a fluid state, it was sometimes employed like the modern carcass by soaking in it tow, &c. and then used as an incendiary; 5th. That it does not appear upon any testimony extant that nitre, or salt petre en-

tered into its composition ; 6th. That as it regards sulphur, that substance might have been employed, as oils will readily unite with it, a fact well known in the proportion of the balsam of sulphur of the old pharmacopeias ; and 7th, and lastly, that when gun powder became known, it superceded the Greek fire, the true preparation of which was lost. It is evident, nevertheless, that as we possess a more perfect knowledge of the properties and effects of bodies than the ancients, a composition might be made, or the present incendiary fire works improved, so that water itself would not extinguish flame, but on the contrary facilitate combustion. For this purpose I submit the following hasty interrogatories :

What would be the effect of nitrate of potash, camphor, and naphtha, if mixed and inflamed, and then brought into contact with water ?

What would be the effect if a given quantity of gun powder were added, the naphtha being previously thickened by the addition of turpentine, or in its place with tar, or some rosin dissolved in the naphtha ?

If in lieu of nitre, chlorate or hyperoxymuriate of potash be used, would not the effect be more powerful, and detonation probably follow ?

Suppose the ingredients of which gun powder is composed, viz. nitrate of potash, charcoal, and sulphur be added separately, in due proportions, to a compound of naphtha and camphor, with or without the addition of spirits of turpentine ; would not such a mixture resist very powerfully the action of water ?

If to the above be added quicklime in powder, would not the quicklime when brought in contact with water increase the combustion by becoming *slacked*, and consequently evolve caloric, provided that no combination was previously formed with the oil and lime, forming a soap of lime ?

What would be the effect, if with the substances before mentioned (the composition being sufficiently thick,) the filings of iron, or in preference zinc were added, especially if the matter in the state of combustion be brought in contact with water ?

If phosphuret of lime be used, would it not add to the combustion when water is thrown on, or the inflamed substance put into water, by decomposing that fluid; thus producing phosphureted hydrogen gas?

Not having a sufficient quantity of naphtha, prevents our making such experiments with that substance. As a substitute, we would recommend highly rectified oil of turpentine, which might be employed, in many respects like naphtha, and be susceptible of great inflammability. We know it to have been used in incendiary fire works, especially in the experiment we mentioned to have been made in Philadelphia during the late war. Nearly of the same character is the *fire-flask* or *fire-bottle*, which is nothing more than a bottle charged with grain-powder mixed with a composition called fire-stone. The bottle is covered with a cloth and sewed, and then coated with pitch. The mouth is secured with parchment, and when used, a match is inserted, and inflamed. It is then thrown by the hand.

Having mentioned an incendiary preparation invented, or recommended by *Casimer Siemienowich*, which appears to have been predicated on the effects of a Greek fire, and which is mentioned by him in his work, entitled *Artis Magnæ Artilleriæ*; it may not be improper to add, *Siemienowich's Fire-rain*, as the preparation is called, is calculated for firing the houses of a besieged place or city, which are covered with shingles, laths, stubble or reeds. It was named *fire-rain* from its resemblance to a shower of rain. Several formulæ are given for this preparation; but the original appears to have been the following: Take 24 parts of sulphur, and melt it in a copper or iron pot, over live coals without flame, and then throw in 16 parts of nitrate of potash, and mix it with an iron spatula. Remove the vessel from the fire, and when the composition has become rather cold, stir into it 8 parts of grained gun powder. Pour the mixture on a slab, and allow it to cool. Before using it, it is broken into pieces of the size of a walnut, and put into shells along with quick match and gun powder. The shells are discharged from mortars in the usual manner, which burst, and thus the composition is dispersed in the state of inflammation. This composition it will be sufficient to add, is now disused; but it gave rise to prepara-

tions of a more powerful nature, and having the same use, as, for instance, the *roche 'a feu* of the French, usually called fire-stone; a composition which is either used in lumps and put into shells with powder, or made into carcasses, or fire balls. We do not know of any imitation of the original Greek fire having been used in modern warfare, but have no hesitation in believing, that naphtha prepared as already stated would in many cases prove advantageous. It seems to be well calculated for close naval combat, if the object be to destroy the sails and rigging of an enemy's ship. The rapidity and extent of its combustion, added to the circumstance of its peculiar properties, that of resisting the action of water in particular, contribute altogether to this opinion.

West-Point, Dec. 11th, 1822.

ART. XII.—METEORS.*

THE appearance of the Meteor, which in March 1822, passed over some of the northern states, brought to our recollection, some statements of similar events, which have been a good while on our files. Perhaps we cannot offer an adequate apology to those who were so obliging as to communicate them, why they have not been published earlier. By the delay, they will have gained at least this advantage; that their importance will be increased, by being presented in connexion with the more recent, and perhaps more interesting phenomenon of the same class.—*Editor.*

Meteor in Ohio.

Extract of a letter from Dr. HENRY MANNING, to the Editor, dated Youngstown Ohio, Aug. 9, 1819.

A large meteor made its appearance on the evening of July 24th. I had a clear view of it at the time it exploded

* This article was prepared for the June No. of this Journal 1822, but has been unavoidably postponed to this time, April 1823.

and for a few seconds before. The pleasing surprise which the view of it occasioned prevented me from at first attending to the time, but as nigh as I could estimate, it was about three minutes from the apparent explosion until the report was heard. The sound resembled that of a heavy cannon at 3 or 4 miles distance fired in a still evening. The course was nearly north. A gentleman who was in the township of Gustavus precisely 20 miles north from the place where I was, saw the light and thought the sound succeeded in something more than a minute.

It is a little more than 40 miles from this place to the south shore of Lake Erie; and much of the country south of the lake, is still a wilderness, making it uncertain whether any discoveries will be made if meteoric stones have fallen. If they should be discovered, perhaps they will not be worth sending a distance to analyze, the results of former experiments having been so uniformly the same.

H. M.

The Pennsylvania Meteor of Nov. 1819.

The following account of the meteor which was seen in Chester county, Pennsylvania, on the 21st of Nov. 1819, we have extracted from the American Watchman. After some introductory observations the Editor remarks:—

“While standing in the open air, we were surprized by a sudden flood of light sufficient to enable us to read the smallest print. We soon discovered a fireball in motion in a direction east northeast, and 50 or 60 degrees above the horizon. It passed a little to the south of our zenith, towards the opposite point of compass, and about 30 degrees above the western horizon it became invisible. This body was, perhaps, about two seconds in progression, before we saw it; from which we infer, that it first appeared about 30 degrees above the eastern horizon; hence it travelled, whilst within view, about 120 degrees in the heavens, and in a period, we believe, of not less than five nor more than ten seconds. The size of the body, when first observed, might be about half that of the full moon. The tail which projected from it was of a conical shape, well defined, and extending from the ball to the apex, about 4 or 5 degrees.

No sparks were observed. The whole appeared to be a compact mass of fire, in which was combined all the redness of Mars, and the softer light of the moon. The whole appearance was sublime, beyond description. At about 30 degrees from the zenith, westward, it began rapidly to decline, and in two seconds became, to appearance, extinct; its tail, in the mean time, lengthening to 10 or 15 degrees, forming a narrow red streak of evanescent fire. About three minutes after it had disappeared, a noise was heard resembling cannon, or distant thunder, and in a *westerly direction*."

A letter respecting this meteor, addressed by Mr. Samuel Turney to the Editor, and dated Chester county, Pennsylvania, Dec. 9th, 1819, states :—

"It passed near Easton on the Delaware, and a sound was heard in the direction of the body. Easton lies nearly north from us. It first appeared here in the northeast at an elevation of about 45 degrees. Its light was very vivid—a blaze streaming from it to a considerable distance. When it had arrived at about 40 degrees from the horizon in the south or southwest it suddenly disappeared, and after a lapse of two, three, or four minutes, two reports were heard. The sound continued (a succession of echoes I suppose) for many seconds.

You will not hesitate to pronounce this for the want of a better name a terrestrial comet. That it was a solid body cannot be doubted if we consider its velocity. Its height must have been at least twenty miles, and it passed through our hemisphere in a very few seconds. No gaseous body could be carried at this rate, moving as they uniformly do, I believe, with the currents in the air.

The sound heard at Easton about sixty miles north of us, could not be the same, I think, with that heard here, which came from a point not less than thirty miles to the south. The body then must have been ignited a second time.

I have not been able to get such information as I wish with regard to the apparent size of the body. It is, by many who were capable of judging in such a case, declared to have been of about one third of the apparent size of the moon, by which I understand that its diameter appeared to them

about equal to a third part of the moon's. Taking this apparent diameter and the distance of twenty miles we shall make the body more than one hundred yards in diameter. My estimate of its elevation above the earth is obtained by comparing the observations made by various persons in different positions.

The course of this meteor compares very well with that which passed over Connecticut in 1807. May it not be the same? * I now suppose it to revolve round the earth. If it be the same, it is a little extraordinary that it should pass so near to the former meridian. But perhaps it has made several revolutions since that period."

Meteor of March 9, 1822.

As the only sources of information within our reach, we were laying by the newspapers, containing the accounts of this meteor, when we observed with pleasure, that Theodore Dwight, Esq. Editor of the New-York Daily Advertiser, had collected the most interesting of these accounts into one view, of which we gladly avail ourselves on the present occasion, as the facts are worthy of being preserved, and it is only by accumulating well authenticated facts of this kind, that we can hope to solve the phenomena of Meteors.

The Meteor.

The late meteor was seen in this city sometime after 10 o'clock; its direction being from southwest to northeast. It appeared to many persons as large as the moon, emitting a brilliant light, which lasted but a few seconds.

It appears from a statement in the Troy Post, that it was seen by a number of gentlemen in that city. One of them, accustomed to astronomical observations, states, that when he saw it first, it was at the altitude of 46 degrees,

* Its size, as conjectured by Mr. Turney, is much less than the estimated size of that meteor.—Ed.

bearing north 20 degrees east. It disappeared at the altitude of 22 degrees, bearing south 80 degrees west. The report, supposed to be caused by its explosion, reached the place of observation about seven and a half minutes after its disappearance. To several, who observed it in full view, it appeared equal to about two-thirds of the apparent diameter of the moon, leaving a luminous track in the heavens which was not totally extinguished in several minutes after the meteor disappeared. The same persons heard two distinct explosions, with a very short interval of time between them. The last they supposed to have been caused by the bursting of one of the largest subdivisions, immediately after the main body had been severed by the first explosion.

Mr. Doty has published a letter in the Albany Gazette, communicating his observations on the meteor as it appeared to him. He was on the Mohawk turnpike, near Canajoharie, about 10 o'clock P. M. when he observed it. He first observed a sudden flash of light which appeared to extend from the heavens to the earth, and was followed by a momentary darkness, as if a cloud had passed over and intercepted the light. This darkness was soon dispelled, and the blazing meteor was in full view over his head, appearing to be twenty or thirty feet in diameter, and soon began to extend itself to the northeast and southwest, increasing in extension, and decreasing in its flaming appearance, until nothing was to be seen but two detached parts of it rapidly moving in different directions towards the northeast and southwest. Mr. Doty calculates that it was five or six minutes from the first appearance of the meteor until it finally vanished, and from six to ten minutes from its first appearance before the report of its explosion reached him, which resembled the noise of distant cannon, and was followed by a strong sulphurous smell, that lasted fifteen or twenty minutes. Its explosion, from his statement, also appears to have sensibly affected several houses.

The Cherry Valley Gazette also mentions this remarkable phenomenon. It was seen about 10 o'clock from that place, globular in its appearance and uncommonly luminous, moving with great velocity from northeast to southwest, and when it disappeared its explosion was distinctly heard. It was visible for several seconds, and from its uncommonly

vivid appearance, caused many persons to close their eyes, rendering candles for an instant perfectly useless.

The Oxford (Chenango) Gazette says, it resembled a ball of fire, the apparent diameter of which was about six feet; and that it was more brilliant than the most vivid flashes of lightning, or even the meridian sun.

The Herkimer paper observes, that an explosion was heard from the south, about four minutes after the meteor passed, which resembled the discharge of four or five pieces of artillery.

A writer in the Sangersfield, Oneida, Intelligencer, says:—

“After passing almost in a direction from north to south, for the space of half a mile, it passed me, as near as I could judge, about three hundred yards, when it burst with a violence which seemed to throw all nature into convulsions. It discharged its massy balls of electric fire in every direction, when all disappeared before they reached the ground; leaving in its train an astonishing mass of livid fire, which remained after the explosion, for the space of ten minutes, and then gradually disappeared like the rain bow.”

The Sentinel (printed at Saratoga Springs) says:—

“A very large and brilliant meteor passed near this village on Saturday last in the direction of southwest. The light produced, for a few seconds, was sufficient to enable many of the inhabitants to discern, in their dwellings, the most minute objects. A report, like the sound of distant thunder, succeeded.”

It was seen about 10 o'clock, at Ballston Spa, and a paper printed in that village, says, its light was so intense “as to arrest persons walking as if they had received an electric shock. At an elevation of about 10 degrees it gave out corruscations like a beautiful rocket—leaving a luminous train, and on its disappearance, two and some say three, reports were heard.”

The Montreal Herald, thus notices the meteor as seen at that place.

“As two gentlemen were walking down St. Paul-street about half past 9 o'clock last Saturday night, their attention was attracted by a flash of light that illuminated the atmosphere, notwithstanding the radiance of a full moon. As it apparently proceeded from the south side of the river, and

the line of houses intercepted their view, they turned down one of the little streets leading to the quay, where having arrived, they beheld a little to the westward of Laprairie, an arched chain of fire, vividly delineated in the heavens, and concaving towards the earth. After a minute or two, it disappeared, having been probably caused by the eruption of a ball of that element which emitted the flash."

The *Quebec Gazette* gives the following description of it.

"The meteor of Saturday evening, the 9th of March, was seen from the vicinity of this city in a southwesterly direction, at about 10 o'clock. It had, when first descried, the appearance of a shooting star, larger than a star of the first magnitude. Its altitude about 45 degrees, its direction in a straight line towards the earth, inclining towards the west; at about half the descent, it divided into numberless pieces, having the appearance of the stars usually thrown from sky rockets, but of a superior brilliancy and beauty, the whole disappearing before they reached the horizon. The sky was clear, the moon nearly at full, in an opposite direction, and the light of the meteor when it divided, was so strong as entirely to destroy the shadows of the moon light and throw them into a contrary direction. From the meteor having been seen at Montreal and Quebec very nearly in the same direction, its distance must have been great."

The *Salem (Washington county) Post*, says,

"Its first appearance was northeasterly about 20 degrees above the horizon, that it passed above the polar star, disappeared about 30 degrees above the horizon, near the constellation Orion; was visible about one minute, and that it appeared about as large as the full moon."

In addition to the above named places it was seen a Boston, Bennington, Vermont, Utica, Johnstown, in Montgomery county, Buffalo, various places in New Hampshire, Rhode Island, and Pennsylvania, but no particular observations accompanied the accounts.

The *Springfield (Massachusetts) Federalist*, states, that an extraordinary meteor was seen on Saturday night, the 9th of March, by several persons in that town and vicinity. It was uncommonly large and brilliant.

The *Eastern Argus*, printed at Portland, state of Maine, says the meteor was seen in that town at a quarter past 10 o'clock in the evening of the 9th, in a direction nearly west, its magnitude nearly that of the moon—its brilliancy very great—and when it exploded, scintillations, not unlike those of sky rockets, were scattered northerly and southerly.

The same meteor was seen in various places East of New-York. The *Bridgeport Courier* says, "its size appeared to be that of a large artificial globe, and moved with great velocity in a direction from northeast to southwest, leaving a trail of immense size and peculiar brightness."

It is remarked by a Boston Editor that this meteor must have been very large and the sound at its separation louder than the loudest thunder, as its explosion was not only seen in many opposite places, but heard from Portland, in the state of Maine to 60 miles west of Albany.

A writer in the *Albany Daily Advertiser* in commenting on Mr. Doty's statement mentioned above, says;

"Eight minutes was the time between its appearance and the report of its explosion, its distance from him must have been about one hundred miles, for sound travels about thirteen miles in a minute. From these data we may calculate that the place where it was vertical must be about seventy miles from Albany in a northwesterly direction, and that its size was near a mile in diameter; but to enable us to calculate with greater accuracy its height, dimensions, and the tracts of country over which it passed, observations at places to the west as well as to the east of it are necessary."

Remark by the Editor, December 9th, 1822.

The following communication from Professor Dean of the University of Vermont has been recently received, and we give it in connexion with the preceding communications to which it bears an important relation.

To the Editor of the *American Journal of Science*.

Sir,

The meteor of last March (1822) has ceased to be the subject of general conversation, but it is not the less inter-

esting to those who wish to explore the causes of such phenomena. The following observations would have been communicated immediately had I not hoped to obtain others to compare with them; but in this I have not succeeded, and I now transmit them with such inferences as they afford:

Capt. Allen Wardner of Windsor, Vt. states, that on the 10th of March, about 10 o'clock in the evening, he was walking along the east side of what is called the tontine building in that village and had just reached the southeast corner, when the first corruscation burst forth. His first thought was that a large barn northwest of the tontine had suddenly burst into a flame, and he hastened on to get a sight of it across the southwest corner of the building, but had not proceeded more than three steps when the body of the meteor came in sight over the south end of the roof, and he had a full view of it for more than 40 degrees moving southwest and descending towards the horizon, until it disappeared behind the ridge of a house forty or fifty rods distant. It was excessively bright, and sparkles were flying from it in all directions and left a dusky reddish track which continued especially about the middle of its length for two minutes. He thought it was nearly round, and its diameter somewhat less than that of a ball which surmounts the dome of the Episcopal Church which was near its apparent path.

The village of Windsor is by estimation in lat. $43^{\circ} 29'$ lon. $72^{\circ} 29'$. I had no theodolite to determine the azimuth, but I ascertained the meridian sufficiently near, as I thought, by the north pole, and measured the sides of a right angled triangle, one angle of which was contained between the meridian and the end of the building, and finding the angles by the traverse table, I ascertained that it declined $20^{\circ} 30'$ toward the west. The second or third steps taken after the first flash subtended an angle at the west corner of $3^{\circ} 45'$, so that the bearing of the meteor when first seen was about north $65^{\circ} 45'$ west. Capt. W. had no object by which to regulate his recollections of the altitude, but he fixed on a point the altitude of which I found to be $29^{\circ} 30'$. I determined the azimuth of the meteor at its disappearance in the same manner, and found it to be, south $67^{\circ} 30'$ west, and its altitude $11^{\circ} 30'$. Then

withdrawing from the ball on the top of the church till Capt. W. thought its apparent diameter was about equal to that of the meteor, I measured it with a sextant and found it 10'.

Col. Lemuel Page, of Burlington, Vt. was in his back yard at the time above mentioned, and had his attention arrested by what is commonly called a shooting star, no way differing from such as frequently appear in considerable numbers. When he first saw it he thought it about in the centre of the triangle formed by lines joining Mars, Castor, and Procyon. It moved on southwesterly, passing a little southeast of Procyon, and about one third of the way from Procyon to Sirius it suddenly broke out in great splendor, and continued its course flashing and sparkling, east of Sirius, and disappeared, apparently by extinction, near the tops of some trees about twenty rods distant, considerably above the mountains in that direction. Col. P. thought its motion exactly perpendicular to the horizon. The disc appeared to be nearly circular, and its diameter about half the breadth of a certain chimney a few degrees east of its apparent path.

The place of this observation is in lat. $44^{\circ} 28'$, lon. $73^{\circ} 15'$. The azymuth of the meteor during its whole course as determined both by the north pole and the globe, was about south 34° west. Its altitude when first seen by Col. P. was about 62° , the first coruscation when it became an object of general attention, and when Capt. W. first noticed it 35° , and at its disappearance 6° . Its apparent diameter, obtained by measuring the breadth of the chimney with a sextant was 12'.

The places of the meteor computed from these observations, by Dr. Bowditch's rule given in Mem. A. A. Vol. 3, are, at its first brilliant coruscation, lat. $43^{\circ} 54'$, lon. $73^{\circ} 47'$, about fifty-nine miles from Burlington and eighty-three from Windsor, over the unsettled part of Essex county, N. Y. about fifteen miles west of Crown Point, and at its disappearance from Capt. W. lat. $42^{\circ} 45'$, lon. $74^{\circ} 49'$, one hundred and forty-four miles from Burlington and one hundred and thirty-three from Windsor, over the western part of Schoharie county, and its motion south 34° west. In the former place according to Capt. W's. observation it was about forty-one miles from the earth, according to

Col. P's. only thirty-four; in the latter place Capt. W's. observation makes its height about twenty-nine miles. If these agreed better with each other, and could be depended upon as nearly accurate, it would be easy to compute from them its height and distance at the beginning and end of its appearance to Col. P. But altitudes estimated under the impression which such a phenomenon cannot fail to produce must be considered as very uncertain whatever may be the judgment and fidelity of the observers. The probability is that when first seen by Col. P. it was near the zenith of Essex, a village on the west shore of Lake Champlain thirteen miles from Burlington, and when it disappeared from him it had reached nearly to the zenith of Wilksbarre in Pennsylvania, about two hundred and fifty miles from Burlington.

The absolute diameter of the meteor, computed from the apparent diameter above estimated and the mean distances of the observers respectively amounts to about one third of a mile.

I hardly dare to make any estimate of its velocity. I have heard no estimate of the duration of the appearance of the body of the meteor greater than five seconds and this would imply a velocity much greater than that of the earth in its orbit.

The observation of its first appearances as noticed by Col. Page is I believe rather uncommon, though perhaps they may always commence in the same manner without being noticed till their light is greatly increased.

Much of the country over which it passed being a wilderness, and none of it populous, it is not probable that if any fragments fell from it, they were recognized next day as any thing more than common stones.

The testimony of Mr. Doty who according to the news papers saw it at Canajoharry passing near the zenith confirms the course above computed.

Yours with high respect,

JAMES DEAN.

ART. XIII.—*Pluviometrical Observations, made at West-Chester, Penn. by WM. DARLINGTON, M. D. and communicated in a letter, dated*

WASHINGTON CITY, Feb. 14, 1823.

Sir,

IN the year 1817, (on the 20th of June.) I commenced keeping an account of the *quantity of rain and snow* which fell in the borough of *West-Chester*, in the State of *Pennsylvania*—a statement of which I now submit to you; and if you should be of opinion that it is worthy of preservation in your *Scientific Journal*, it is entirely at your service. If observations of this description were made for a series of years, in the various sections of the *United States*, they would undoubtedly tend to furnish us with more accurate conceptions of the nature of our climate, as well as with the means of comparing it with that of other countries. They would also enable us to ascertain, in the course of time, the real character of those *changes* which are supposed to be taking place in the climate of this continent, by reason of cultivation, clearing of forests, and other causes. Some useful data, likewise, might possibly be afforded by such accounts, to assist *Medical Philosophers* in investigating the causes and character of prevailing diseases, in the country. In the present instance, I have to regret the occurrence of an hiatus in the account, from 29th November 1819, to March 7th 1820, owing to the accidental loss of my memoranda for that period: but the statement for the residue of the time embraced, may be relied upon as being complete, and tolerably accurate. I am sensible that it would have been much more satisfactory, if it had been accompanied with *Thermometrical and Barometrical* observations; but I had it not in my power to furnish a statement of that sort as fully as could be wished, and have therefore omitted it altogether.

Synopsis of Pluviometrical observations.

Months.	1817	1818	1819	1820	1821	1822	Average.
January	- -	2.1	1.1	- -	4.3	2.3	2.4
February	- -	2.0	4.0	- -	3.9	4.3	3.3
March	- -	3.7	4.35	} fr'm 6th 1.3	1.6	2.4	3.4
April	- -	2.77	2.6		3.45	3.2	3.5
May	- -	8.8	4.75	7.9	7.2	3.5	6.4
June	{ fr'm 19 5.5	4.6	1.8	3.4	4.15	2.35	3.6
July		2.55	8.25	4.3	4.0	3.6	4.36
August		7.05	4.7	4.2	2.9	1.9	2.2
September		4.2	4.4	1.95	4.1	7.9	4.5
October		2.07	1.2	1.5	10.1	5.4	2.5
November		5.85	3.45	{ 1.4 to Nov. 29	3.8	5.3	7.0
December		3.6	1.86		3.6	3.5	1.45
Inches		30.82	48.83	31.12	43.5	52.6	39.3

Thus it appears that the *average* quantity of water which fell in the time stated, was about *forty-six inches a year*. The greatest quantity, 52.6 inches; (viz. in 1821) and the least, in any *entire* year, 39.3 inches (in 1822.) The quantity, in 1819, was probably still less; being only 31.12 inches from Jan. 1, to Nov. 29.

I find by my notes, that the quantity of *snow* which fell, during the above period, was as follows:

	Inches.	Inches.
In 1818, there was <i>snow</i>	12.	equal to 1.7 of water
" 1819, (to Nov. 29.)	45.	- 5.3
" 1820, (from March 6.)	4.	- .3
" 1821, - - -	30.	- 3.1
" 1822, - - -	22.	- 2.2
	snow 113.	12.6 water

The water which fell in the form of *snow*, is included in the foregoing table of rain.

The number of days of *falling weather*, so called, (including both rain and snow) in those years, is exhibited in the following table: by which it appears that the highest number is 103, (in 1818) and the lowest, in any entire year, 84, (in 1822.) The *average* number of days, on which there

fell either rain or snow, is about 91 out of 365; or about *one day in four*, of the year.

TABLE, showing the number of days of *falling weather* in each month, in the years noted.

Months.	1817	1818	1819	1820	1821	1822	Ave- rage.
January	- -	7	5	- -	8	6	6½
February	- -	5	8	- -	11	6	7½
March	- -	9	11	{ fr'm 6th 5	5	5	7
April	- -	11	6	4	8	10	8
May	- -	13	16	14	13	7	12
June	{ fr'm 19 5	13	5	7	8	7	8
July	9	8	8	9	9	9	9
August	9	10	9	6	5	4	7
September	6	8	8	3	11	7	7
October	9	3	4	5	5	4	5
November	6	6	{ 3 to Nov. 29	5	7	10	6
December	6	10	- -	7	9	9	8
Days	50	103	83	65	99	84	91

The latter part of the summer of 1822, was marked by a severe drought—so much so, that many wells and springs dried up, which had never before failed within the memory of the oldest inhabitants. Even the rain which did fall, seemed to be speedily dissipated, without producing any refreshing effect upon vegetation. The season was also remarkable for the prevalence of *intermittent fevers*, in the neighbourhood of West-Chester; a form of disease which has hitherto been extremely rare in that vicinity. Along the waters of the Schuylkill, and Susquehanna, fevers of a more malignant type prevailed extensively.

I am, Sir,

very respectfully,

your most obed't.

WM. DARLINGTON.

Prof. SILLIMAN, New-Haven.

ART. XIV.—*Cure of Asthma by a Stroke of Lightning.*
(Communicated by the Rev. RALPH EMERSON.)

Norfolk, Nov. 25, 1822.

To the Editor.

DEAR SIR,

I know not whether electricity has ever been tried for the relief of persons afflicted with Asthma. If not, perhaps the following circumstances may suggest the propriety of making the experiment.

One year ago last August, Mr. Martin Rockwell of Colebrook, Conn. was severely affected by a shock of lightning, which struck his buildings within about ten feet of him. He was standing at the time in a leaning position, looking out at a window, bearing most of his weight on his left foot, and supporting himself by his right arm, with his hand on a moist platform connected with a sink, and these together forming a connection with the part of the building where the charge fell. Without his either seeing the flash or hearing the noise, his right arm and left leg were instantly paralyzed, and sense and reason were for a few moments suspended. On recovery, his first thought was that his arm was gone, and he put up his left hand to feel if it were yet on him. He did not recover the use of his arm or leg for an hour; and they continued sensibly affected for some days. No other part of his body was particularly affected, except the chest. He felt a strong sensation at the lungs, and they continued sore for a number of days. I state these circumstances, as they evince that a heavy charge of electricity passed through the vitals.

Mr. R. is now fifty years of age, and from his youth had been so subject to the asthma as to be often unable to rest in bed for a number of months together, especially in autumn. Since this event, however, he has been entirely free from it, except in one or two instances he has felt a very slight degree of it, after great fatigue, and under the pressure of a severe cold. He has now passed the second autumn in health since this kind preservation of life and removal of disease.

I visited him soon after the shock, and witnessed the demolishing effects of the lightning. The place where it struck is a projection of one story, at right-angles with the house, which is two stories high, and within a few feet of their junction. Mr. R. was in the house at the time. It was rather difficult to decide whether the lightning ascended or descended—the appearances rather indicated the latter. The side of the building was laid nearly bare of its covering, from the eaves to the ground; and most of the nails in a contiguous door were started, and one window near the angle with the house was completely shattered, and the glass thrown *outward*, I suppose by the concussion, and the pressure of the air or fluid with which the apartment was filled. Much smoke and sulphureous smell were observed on entering this apartment. The point at the eaves where the first vestiges of the lightning were perceivable, was directly under the branches, and but three feet from the trunk of a lofty poplar, which remained unhurt—thus affording an additional proof to what is stated in your No. for June last, that this tree is a poor conductor and no safe-guard against lightning. I would remark also, that there was a good rod to the house, sixty-three feet distant from the smitten spot.

ART. XV.—*Galvano-Magnetic Apparatus of Prof. DANA.*

(See Figure 6 in Plate 12 at the end.)

A, is a cork through which passes a strip of sheet copper C, about one quarter of an inch wide and eight inches long, bent at the bottom like the letter U, so as partly to inclose the strip of sheet zinc Z, of the same width as the copper; NS is a steel wire five inches long, around which passes about seventy-five turns of brass wire. One end of this passes through a perforation in the upper part of the copper, and the other through a similar perforation in the zinc. The brass wire is covered with sewing silk; when his little apparatus is placed in a tall glass jar containing water, acidulated with sulphuric or nitric acid, the wire NS soon arranges itself in the plane of the magnetic meridian; the steel wire becomes a temporary magnet, and will

attract fine iron filings, so long as the apparatus remains in the dilute acid, but instantly loses that power when withdrawn from the liquid. One curious result is presented by this apparatus, which we should not have anticipated from experiments made by myself with common electricity, and which I sent to you when I last wrote, nor from the experiments of Mr. BOWEN, with HARE's calorimotor; it is this: when the spiral brass wire passes from *right to left*, the *north pole* is found on the *negative* or *copper* end; if from *left to right*, that pole is found on the *positive* or *zinc* end; this effect is like that noticed by *Van Beck*. It certainly indicates *another* point of difference, which Dr. Hare justly asserts to exist between common galvanic instruments and his calorimotor; and the result of Mr. Bowen's experiments, and my own with common electricity, points out an analogy between the effects of the common electrical machine and of the calorimotor. I have tried in vain to communicate such a degree of magnetism to silver and platina wires by this little apparatus as to induce them to assume a north and south direction; and I have in vain attempted to influence delicately suspended galvanic apparatus by the rays of light separated by a prism; but I doubt not that some fortunate philosopher, in possession of a heliostadt, will be able to produce some effect in this way.

Dartmouth College, Hanover, N. H.

ART. XVI.—*Analysis of the Glassy Actynolite from Concord Township, Delaware Co. Penn.* By. H. SEYBERT.

COLOR in the mass, emerald green; powder greenish white. Lustre vitreous. Translucent. Fracture in one direction fibrous, in the opposite irregular. Very frangible. Scratch-es glass. Structure fibrous and fasciculated. Specific gravity 2.987. Fusible, before the blowpipe, into an opaque greenish enamel.

Analysis.

A. 3 grammes of the mineral, in the state of an impalpable powder, after exposure to a red heat, with the contact of air, had assumed a reddish tinge, and weighed 2.98

grammes; but as the protoxide of iron contained in the mineral must, during the calcination, have passed to the state of peroxide, and as the absorption of oxygen, estimated by calculation, is 0.011 grammes, therefore the moisture expelled by calcination amounts to 0.031 grammes on 3 grammes, or 1.033 per hundred.

B. The calcined mineral (*A*) was exposed to a red heat during thirty minutes, in a silver crucible, with 9 grammes of caustic potash. The cold mass was of a pale green color; it communicated to the water with which it was treated, a lemon yellow color, thus indicating a trace of chrome. The mixture was treated, in the usual manner, with an excess of muriatic acid, and the yellow solution thus produced, was evaporated to a dry gelatinous mass, which was treated with diluted acid and again moderately evaporated. The residue was treated with more water, and the solution was filtered; the silica collected on the filter, after being washed and calcined, weighed 1.69 grammes on 3 grammes, or 56.333 per 100.

C. After the liquor (*B*) was neutralized with caustic potash, on the addition of the hydro-sulphate of potash, a black precipitate was formed, which, after being washed and calcined with nitric acid, weighed 0.19; this precipitate, when treated with caustic potash, was found to consist of 0.14 grammes of peroxide of iron, and 0.05 grammes of alumine, by difference 1.666 per 100. Owing to the green color of the mineral, the iron must be estimated as a protoxide, and the 0.14 grammes of peroxide are equivalent to 0.129 grammes of protoxide on 3 grammes, or 4.30 per 100. The alkaline liquor holding the alumine in solution, appeared to be yellow from chrome contained in the mineral; to detect the chrome, the alumine was precipitated, by exactly neutralizing the liquor with muriatic acid; on the addition of acetate of lead, there was produced a precipitate of muriate of lead, intermixed with a yellow precipitate of chromate of lead; to another portion of the liquor, nitrate of silver was added; the muriate of silver was likewise intermixed with a red precipitate of chromate of silver, but the chrome seemed to be very trifling.

D. When oxalate of potash was added to the liquor (*C*) it occasioned a white precipitate, which, after a strong calcination, afforded 0.32 grammes of lime on 3 grs. or 10.666 per 100.

E. The liquor (*D*), when treated with an excess of caustic potash, afforded 0.72 grammes of magnesia on 3 grs. or 24.0 per 100.

The constituents of this mineral are, therefore,

	Per 100 parts.	
<i>A.</i> Water	1.033	Containing oxygen,
<i>B.</i> Silica	56.333	28.33
<i>C.</i> Protoxide of iron	4.300	00.97
<i>C.</i> Alumina	1.666	
<i>D.</i> Lime	10.666	03.84
<i>E.</i> Magnesia	24.000	9.29
<i>C.</i> Protoxide of chrome a trace.		
	97.998	
	100.000	
	2.002	Loss.

ART. XVII.—*Analysis of Argentine and Crystallized Steatite.*
by Professor DEWEY.

Argentine.

At the lead-mine in Southampton, Mass. a mineral is found in considerable quantity, which is a nearly pure carbonate of lime, and has the following characters. It generally consists of undulated, not parallel, laminæ, of a pearly shining lustre, often of a beautiful silvery white. Sometimes it is in thin plates, which intersect and form small cells, containing crystals of calcareous spar. The thin laminæ are translucent. Sometimes it is less laminated and more compact, with less lustre, and the cross fracture is slightly granular. It was supposed to contain magnesia, and three years since I examined it without detecting any of this earth. It was then laid by as a beautiful carbonate of lime, without a suspicion of its being one of the subspecies of this mineral. The characters prove it to be *Argentine*.

It occurs on very compact granite, and is also associated with fetid quartz, which is found in small masses in it and upon it. When it joins the quartz it is more compact and

hard, and a small quantity of silex seems to enter into the composition of the mineral.

Heated to a temperature of 300° or 400°, it did not lose weight. It gave no indications of even a trace of oxide of manganese, which is sometimes found in argentine, and of only a very small quantity of magnesia. At least, only a minute quantity was separated from the lime by carbonate of ammonia. 100 grs. of the mineral yielded, of

Carbonic acid	-	-	41. grs.
Lime	-	-	54.
Silex	-	-	3.25
Magnesia and Oxide of Iron			0.75
Loss	1.00	probably carb. acid.	
100.00			

If the the silex is to be considered an accidental ingredient, arising from the specimen being associated with quartz, this argentine is a very pure carbonate of lime.

Crystallized Steatite.

Having ascertained that the mineral contained silex, magnesia, alumine, water, and oxides of iron and manganese, one hundred grains of a very large and fine crystal were analyzed to ascertain the proportion of the ingredients. In the previous trials, the proportion of some of them had been found, but as they were not much different from those obtained from this crystal, it was judged proper to rely on the results last obtained. In heating the mineral, there was sometimes more and sometimes less than fifteen per cent. of water liberated; but the water is taken at fifteen per cent. In heating the mineral with sulphuric acid, there was no indication of fluoric acid, which is sometimes found in a variety of steatite. Indeed, the corrosion of the glass vessel in which the experiment is performed, is somewhat equivocal, as sulphuric acid heated to 500° or 600° will act upon the potash or soda in some kinds of glass at least, and an actual corrosion take place. Oxalate of ammonia gave no indication of lime. The method of analyzing those magnesian minerals which are decomposed by

acids, is too well known to make a more detailed statement necessary in the present case. Muriatic acid dissolved all the mineral except the silex, which weighed 50.6 grs. From the muriatic solution carbonate of ammonia threw down the oxide of iron, being 3.25 grs. equivalent, according to Brande, to 2.59 grs. of protoxide of iron. Pure potash separated the alumine, estimated at 0.15 gr. The ammoniacal solution contained the magnesia and oxide of manganese. This solution was evaporated, and the ammoniacal salts were separated by sublimation; the magnesia and manganese remained. They were then converted to sulphates; the solution evaporated to dryness, and the dry mass was kept at a red heat for half an hour. The water was thus driven off from the sulphate of magnesia, and the sulphate of manganese being converted to the deutoxide of manganese, a reddish powder was thus diffused through the sulphate of magnesia. The whole weighed 87.5 grs. and dissolved in water except one grain of deutoxide of manganese, equivalent to 1.1 gr. of the peroxide. This contained, therefore, 86.5 grs. for the sulphate of magnesia, equivalent to 28.83 grs. of pure magnesia. The result is,

Water	-	-	15.00	grs.
Silex	-	-	50.60	
Oxide of iron	-		2.59	
Magnesia	-		28.83	
Oxide of manganese			1.10	
Alumine	-	-	0.15	
Loss	-	-	1.73	
				100.00

This result contains a proportion of ingredients between those given by Klaproth in his analysis of steatite from two different places. There can be no doubt, therefore, that these crystals are *real steatite*.

The *form* of some of these crystals, is that of a six-sided prism terminated by six-sided pyramids, often variously truncated. Some of them appear to be four-sided prisms terminated by a four-sided pyramid. They are unquestionably the crystals intended by Jameson, as they are found in a similar situation to those mentioned by him,

though they seem not to be *pseudomorphous*. The locality is described, Vol. V. p. 249 of this Journal. They are sometimes covered with a very fine grained and close brownish steatite, in which, as in the asbestos, the crystals leave their form. The specific gravity of the crystals is less than that given to steatite. In the various specimens I have tried, it has been found very nearly 2, sometimes a little more or a little less. Their specific gravity may be taken at 2, water being unity.

ART. XVIII.—*On the Cutting of Steel by Soft Iron.*

Extract of a letter to the Editor, from the Rev. HERMAN DAGGETT, Principal of the Foreign Mission School at Cornwall, Conn.

Cornwall, Feb. 3, 1823.

Dear Sir,

I take the liberty to communicate to you a fact, which has lately come to my knowledge, and which, I judge, may be of considerable use in mechanics, and perhaps in philosophy. It may not, however, be new to you.

Mr. Barnes, (a cabinet-maker of this place) had occasion to repair a cross-cut saw, (a saw to be used by two persons) of a very hard plate, which would require considerable labor, in the usual way of filing. He recollected having heard that the Shakers sometimes made use of what he called, a buzz, to cut iron. He therefore made a circular plate of soft sheet iron, (a piece of stove pipe,) fixed an axis to it, and put it in his lathe, which gave it a very powerful rotary motion. While in motion, he applied to it a common file to make it perfectly round and smooth; but the file was cut in two by it, while it received itself no impression. He then applied a piece of rock-crystal, (a piece of which, he informs me, he once presented to you,*) which had the desired effect. He then brought under it, the saw-plate, which, in a few minutes, was neatly and completely cut through longitudinally. When he stopped the buzz, he found it had received no wear from the operation, and that he could immediately apply his fingers to it, without perceiving much

*It was a peice of a very fine and large crystal of smoky quartz.—*Editor.*

sensible heat. During the operation, there appeared a band of intense fire around the buzz, continually emitting sparks with great violence. He afterwards marked the saw, for the teeth, and in a short time cut them out, by the same means. It seemed evident, that the buzz, in effecting the division, never came in actual contact with the plate. Was this fire the electric fluid? If so, might it not be obtained, in greater quantity, and be made more effective for chemical purposes, by some such machine, than in any other way?

ART. XIX.—*On the relations, existing between the Deflagrator and Calorimotor, and between those instruments and the common Galvanic or Voltaic Batteries, in a letter to Professor Robert Hare, M. D. from the Editor.*

Yale-College, April 4, 1823.

Dear Sir,

Through the medium of this Journal, (Vol. 4. pa. 201, and Vol. 5, pa. 102,) I have already communicated to you and to the public, the singular fact, that your Deflagrator will not act with the common Galvanic Batteries, in whatever mode they may be connected, and that, although belonging to the same class of instruments and evolving the same imponderable agents, there still exists between them a total incompatibility. This incompatibility, it will be remembered, does not begin to be overcome, until the pairs of galvanic plates are reduced to twenty, in number, when the power of the Deflagrator *begins* to pass, and increases until one pair only is interposed, when it passes apparently without diminution.

I am induced again to call your attention to this fact, for the sake of connecting it, with some observations which I have recently made, upon the relations between the Calorimotor and Deflagrator, and between these instruments, and the common Galvanic Batteries, for it is only by varying our observations and experiments, that we can hope to arrive at a just explanation, of the singular phenomena exhibited by these instruments.

1. I connected the zinc pole of the Calorimotor, with the copper pole of the troughs, and vice versa, and then dividing the troughs (containing three hundred pairs of four inch plates,*) at another place, connected them at these new poles by points of well prepared charcoal; the sparks passed freely and vividly, nor did it, apparently make any difference, whether the plates of the Calorimotor, were immersed in the fluid, or not. I then disconnected the troughs from the Calorimotor, and connecting them together, received the spark, which was quite as vivid, as when the Calorimotor formed a part of the series. I now immersed the Calorimotor, and found that it acted by itself, with its appropriate energy, readily igniting iron, and displaying its usual magnetic activity.

2. The Calorimotor and Deflagrator were connected in such a manner, that the former was interposed between the two equal divisions of forty coils each, contained in the two troughs of the Deflagrator; in different trials, the connexion was varied, sometimes the zinc poles, and sometimes the copper poles of the two instruments, being connected, and at other times, the zinc of the one being joined to the copper of the other, and vice versa.

When the metals of both instruments were in the air, only a very feeble spark passed through the charcoal points connecting the proper poles of the Deflagrator. When the plates of the Calorimotor were immersed, those of the Deflagrator being in the air, the spark was not increased, but remained feeble as before. The coils of the Deflagrator being then immersed, the usual splendor of light, instantly burst from the charcoal points, and all the dazzling brightness and intense heat of the instrument were displayed, *but without any increase of power derived from the Calorimotor.* The plates of the Calorimotor were now raised from the fluid, those of the Deflagrator remaining immersed, but the light and heat were equally brilliant as before. The Deflagrator and Calorimotor were now separated, and each produced its appropriate effects, in full energy.

3. The Calorimotor—the Deflagrator and the troughs, containing the three hundred pairs of four inch plates, were now connected into one series, in such a manner, that the Calor-

* Cemented in the usual manner, into mahogany boxes.

imotor was interposed between the two halves of the Deflagrator, the proper poles of the latter instrument were connected with the two divisions of the troughs ; first, zinc, with copper, and copper with zinc, and then the reverse, and the power was received at the proper poles of the troughs, charcoal points being used as before.

When the metals both of the Deflagrator and Calorimotor were in the air, a spark passed, such as corresponded with the power of the troughs only ; when the Calorimotor was immersed, this power was neither increased nor diminished ; but when the Deflagrator was immersed, its power flowed freely through the batteries, and was received apparently undiminished at the charcoal points, but did not appear to derive any increase from the troughs. This was the fact, whether the Calorimotor was, at the moment immersed, or not, but the lifting of the coils of the Deflagrator out of the fluid, immediately reduced the spark, to that which the troughs alone would afford.

The several instruments being now disjoined, each acted by itself, in its own appropriate character.

4. The original experiment of connecting the troughs with the Deflagrator only, was now again repeated, and with the same result as before ; the power of both instruments was so destroyed, that only a very minute spark could be seen, and that with difficulty.

From these experiments, and those formerly related, the following conclusions may be drawn :—

1. The galvanic troughs and the Deflagrator paralyse each other, and cannot be made by any means hitherto tried, to act in concert.

2. The Calorimotor does not impede the action of the troughs ; it allows their energy to pass through itself, but contributes nothing to aid their power and cannot be made to project its own power through the troughs.

3. The same fact is true of the Calorimotor in relation to the Deflagrator ; the powers of these instruments cannot be made to unite, only the Calorimotor allows a transit to the power of the Deflagrator ; but the Deflagrator does not in its turn, transmit the power of the Calorimotor.

4. The Calorimotor, however, when connected, at once with the troughs and with the Deflagrator enables *them* so far to unite, that the deflagrator acts through the troughs,

but without deriving any increase of power from them or from the Calorimotor; the Calorimotor then is an intermedium for the troughs and the deflagrator otherwise incompatible.

5. It is impossible as far as experiment has gone, to obtain any increase of power by combining the different kinds of voltaic apparatus, and indeed it may be doubted whether, when the power passes at all, through the instruments of different kinds, there is not always some loss, from the increased extent of connecting surface.

6. These various facts are probably all referable to the different powers, belonging to different proportions of the calorific, electrical, and luminous influence, excited by these different instruments, agreeably to the theory, which you have ingeniously proposed and ably defended; this view accords also with the known results of the combinations of ponderable elements, in different proportions, as of nitrogen and oxygen, and of carbon and oxygen, and of carbon hydrogen, and nitrogen.

7. We are thus sent back, to study our imponderable elements anew, and to learn, that the voltaic power is not electricity alone, nor heat alone, nor light alone, but a compound of these three agents, variously proportioned in different cases, and in different modifications of apparatus. This, it appears, is also true, of the common mechanical and atmospheric electricity.

REMARK.

As the magnetic influence attends all the modifications of electricity, natural and artificial, and of the voltaic power, including your new instruments; and as it is exhibited also by the solar beam, we are left in doubt, whether to regard it as a mere appendage of these powers, or of some one or two of them, or as a distinct influence or energy, *incidentally* associated, with the colorific—calorific and electrical powers.

But, as the magnetic influence is marvellously more powerful, in the Calorimotor, than in the case of any voltaic, electrical or optical instrument, and as the Calorimotor evolves chiefly heat, and produces its magnetic effects *best* when it produces *no light* and *no perceptible electricity*, it would seem, as if the magnetic influence were rather an at-

tendant, on caloric, or at least in a greater degree, than on any other power.

It is extremely obvious, that, on all these subjects, we are still very humble learners; we may however, confidently hope, that out of these diversified results, and from others still to be obtained—some *grand simplification* will hereafter arise, which will reconcile all apparently discordant facts, and perhaps evince, that all the imponderable influences are merely modifications of one power—that they constitute the *atmosphere*, which connects physical existence with its author, and exhibit to us, in the natural world, the most immediate and wonderful efflux of his omnipotent energy.

Your friend and servant,

B. SILLIMAN.

ART. XX.—*Fusion of Plumbago.*

Notice of the Fusion of Plumbago, or Graphite, (commonly called black lead,) in a letter to Dr. Robert Hare, M. D. from the Editor, dated March 26, 1823.

MY DEAR SIR,

In a former letter published in this Journal, (Vol. V. pa. 108,) and in an additional notice, (pa. 361 same Vol.) I gave an account of the fusion and volatilization of charcoal, by the use of your Galvanic Deflagrator. I have now to add, that the fusion of plumbago was accomplished yesterday by the same instrument, and that I have, again, obtained the same results to-day. For this purpose, from a piece of very fine and beautiful plumbago, from North-Carolina, I sawed small parallelopipeds, about one eighth of an inch in diameter, and from three fourths of an inch to one inch and a quarter in length; these were sharpened at one end, and one of them was employed to point one pole of the deflagrator, while the other was terminated by prepared charcoal. Plumbago being, in its natural state, a conductor, (although inferior to prepared charcoal,) a spark was readily obtained, but, in no instance, of half the energy which belongs to the instrument when in full activity, for the zinc coils were very much corroded, and some of them had failed and dropped out; still the influence was readily convey-

ed, through the remaining coils. As my hopes of success, in the actual state of the instrument, were not very sanguine, I was the more gratified to find a decided result in the very first trial. To avoid repetitions I will generalise the results. The best were obtained, when the plumbago was connected with the copper, and prepared charcoal with the zinc pole. The spark was vivid, and globules of melted plumbago could be discerned, even in the midst of the ignition, *forming* and *formed* upon the edges of the focus of heat. In this region also, there was a bright scintillation, evidently owing to combustion, which went on where air had free access, but was prevented by the vapor of carbon, which occupied the highly luminous region of the *focus*, between the poles, and of the direct route between them. Just on and beyond the confines of the ignited portion of the plumbago, there was formed a belt of a reddish brown color, a quarter of an inch or more in diameter, which appeared to be owing to the iron, remaining from the combustion of the carbon of that part of the piece, and which, being now oxidized to a maximum, assumed the usual color of the peroxide of that metal.

In various trials, the globules were formed very abundantly on the edge of the focus, and, in several instances, were studded around so thickly, as to resemble a string of beads, of which the largest were of the size of the smallest shot; others were merely visible to the naked eye, and others still were microscopic. No globule ever appeared on the point of the plumbago, which had been in the focus of heat, but this point presented a hemispherical excavation, and the plumbago there had the appearance of black scorix or volcanic cinders. These were the general appearances at the copper pole occupied by the plumbago.

On the zinc pole, occupied by the prepared charcoal, there were very peculiar results. This pole was, in every instance, elongated towards the copper pole, and the black matter accumulated there, presented every appearance of fusion, not into globules, but into a fibrous and striated form, like the half flowing slag, found on the upper currents of lava. It was evidently transferred, in the state of vapor, from the plumbago of the other pole, and had been formed by the carbon taken from the hemispherical cavity. It was so different from the melted charcoal, described in my former communications, that its origin

from the plumbago could admit of no reasonable doubt. I am now to state other appearances which have excited in my mind a very deep interest. On the end of the prepared charcoal, and occupying, frequently, an area of a quarter of an inch or more in diameter, were found numerous globules of perfectly melted matter, entirely spherical in their form, having a high vitreous lustre, and a great degree of beauty. Some of them, and generally they were those most remote from the focus, were of a jet black, like the most perfect obsidian; others were brown, yellow, and topaz colored; others still were greyish white, like pearl stones with the translucence and lustre of porcelain; and others still, limpid like flint glass, or, in some cases, like hyalite or precious opal, but without the iridescence of the latter. Few of the globules upon the zinc pole were perfectly black, while very few of those on the copper pole were otherwise. In one instance, when I used some of the very pure English plumbago, (sawed from a cabinet specimen, and believed to be from Borrowdale,) white and transparent globules were formed on the copper side.

When the points were held *vertically, and the plumbago uppermost*, no globules were formed on the latter, and they were unusually numerous, and almost all black, on the opposite pole. When the points were exchanged, plumbago being on the zinc, and charcoal on the copper end, very few globules were formed on the plumbago, and not one on the charcoal; this last was rapidly hollowed out into a hemispherical cavity, while the plumbago was as rapidly elongated by matter accumulating at its point, and which, when examined by the microscope, proved to be a concretion in the shape of a cauliflower—of volatilized and melted charcoal, having, in a high degree, all the characteristics which I formerly described as belonging to this substance. Indeed, I found by repetitions of the experiment, that this was the best mode of obtaining fine pieces of melted charcoal.

In some instances, I used points of plumbago on both poles, and always obtained melted globules on both; the results were however, not so distinct as when plumbago was on the copper and charcoal on the zinc pole; but the same elongation of the zinc and hollowing of the copper pole took place as before. I detached some of the globules, and part-

ly bedding them in a handle of wood, tried their hardness and firmness; they bore strong pressure without breaking, and easily scratched, not only flint glass, but window glass, and even the hard green variety, which forms the aqua fortis bottles. The globules which had acquired this extraordinary hardness, were formed from plumbago which was so soft, that it was perfectly free from resistance when crushed between the thumb and finger, and covered their surfaces with a shining metallic looking coat. These globules sunk very rapidly in strong sulphuric acid—much more so than the melted charcoal, but not with much more rapidity than the plumbago itself, from which they had been formed.

The zinc of the deflagrator is now too far gone to enable me to prosecute this research any farther at present; as soon as the zinc coils can be renewed, I shall hope to resume them, and I entertain strong hopes, especially from the new improved and much enlarged deflagrator, which you are so kind as to lead me soon to expect from Philadelphia.

April 12.—Having refitted the Deflagrator with new zinc coils, I have repeated the experiments related above, and have the satisfaction of stating that the results are fully confirmed and even in some respects extended. The Deflagrator now acts with great energy, and in consequence I have been enabled to obtain good results when using Plumbago upon both poles. Parallelopipeds of that substance, $\frac{1}{3}$ of an inch in diameter and one inch or two inches long, being screwed into the vices connecting the poles, on being brought into contact, transmitted the fluid, with intense splendor, and became fully ignited for an inch on each side; on being withdrawn a little, the usual arch of flame was formed for half an inch or more. Indeed when the instrument is in an active state, the light emitted from the plumbago points, appears to be even more intense and rich than from charcoal; so that they may be used with advantage, in class experiments, where the principal object is to exhibit the brilliancy of the light.

On examining the peices in this, and in numerous other cases, I found them beautifully studded with numerous globules of melted plumbago. They extended from within a quarter of an inch of the point, to the distance of $\frac{1}{4}$ or $\frac{1}{3}$ of an inch all around. They were larger than before and per-

fectly visible to the naked eye; they exhibited all the colours before described, from perfect black, to pure white, including brown, amber, and topaz colours; among the white globules, some were perfectly limpid, and could not be distinguished by the eye from portions of diamond. In different repetitions of the experiment with the plumbago points, there were some varieties in the results. In one instance only, was there a globule formed *on* the point; it would seem as if the melted spheres of plumbago as soon as formed, rolled out of the current of flame, and congealed on the contiguous parts. In every instance, the plumbago on the copper side, was hollowed out, into a spherical cavity, and the corresponding peice on the zinc side, received an accumulation more or less considerable. In most instances and in all when the Deflagrator was very active, besides the globules of melted matter, a distinct tuft or projection was formed on the zinc pole, considerably resembling the melted charcoal, described in my former communications, but apparently denser and more compact; although resembling the melted charcoal, as one variety of volcanic slag resembles another, it could be easily distinguished by an eye familiarized to the appearances. In one experiment the cavity, and all the parts of the plumbago at the copper pole were completely melted on the surface, and covered with a black enamel. The appearances were somewhat varied when specimens of plumbago from different localities were used. In some instances it burnt, and even deflagrated, being completely dissipated in brilliant scintillations; the substance was rapidly consumed and no fusion was obtained. This kind of effect occurred most distinctly when there was a plumbago piece on the copper side, and a piece of charcoal on the zinc side. I have already mentioned the curious result which is obtained when this arrangement is reversed, the charcoal on the copper, and the plumbago on the zinc side; this effect was now particularly distinct and remarkable, the charcoal on the copper side was rapidly volatilized, a deep cavity was formed, and the charcoal taken from it, was instantly accumulated upon the plumbago point, forming a most beautiful protuberance, completely distinguishable from the plumbago, and presenting when viewed by the microscope, a congeries of aggregated spheres, with every mark of perfect fusion and with a perfect metallic lus-

tre. I would again recommend this arrangement when the object is to attain fine pieces of melted charcoal.

April 14.—In repeating the experiments to day, I have obtained even finer results than before. The spheres of melted plumbago were in some instances so thickly arranged as to resemble shot lying side by side; in one case they completely covered the plumbago, in the part contiguous to the point on the zinc side and were without exception white, like minute, delicate concretions of mammillary chalcedony; among a great number there was not one of a dark colour except that when detached by the knife they exhibited slight shades of brown at the place where they were united with the general mass of plumbago. They appeared to me to be formed by the condensation of a white vapour which in all the experiments, where an active power was employed, I had observed to be exhaled between the poles and partly to pass from the copper to the zinc pole, and partly to rise vertically in an abundant fume like that of the oxid proceeding from the combustion of various metals. I mentioned this circumstance in the report of my first experiments (see Vol. 5, p. 112 of this Journal,) but did not then make any trial to ascertain the nature of the substance. Although its abundance rendered the idea improbable, I thought it possible that it might contain alkali derived from the charcoal. It is easily condensed by inverting a glass over the fume as it rises, when it soon renders the glass opaque with a white lining. Although there was a distinct and peculiar odour in the fume, I found that the condensed matter was tasteless, and that it did not effervesce with acids, or affect the test colours for alkalies. Besides, as it is produced apparently in greater quantity, when both poles are terminated by plumbago, it seems possible that it is white volatilized carbon, giving origin, by its condensation, in a state of greater or less purity, to the grey, white, and perhaps to the limpid globules.

The Deflagrator having been refitted only at the moment when a part of this paper had already gone to the press, and the remainder is called for, I am precluded by these circumstances from trying the decisive experiment of heating this white matter by means of the solar focus in a jar of pure oxygen gas, to ascertain whether it will produce carbonic acid gas.

This trial I have this morning made upon the coloured globules obtained in former experiments; they were easily detached from the plumbago by the slightest touch from the point of a knife, and when collected in a white porcelain dish, they rolled about like shot, when the vessel was turned one way and another. To detach any portions of unmelted plumbago which might adhere to them I carefully rubbed them between my thumb and finger in the palm of my hand. I then placed them upon a fragment of wedge-wood ware, floated in a dish of mercury, and slid over them a small jar of very pure oxygen gas, whose entire freedom from carbonic acid, had been fully secured by washing it with solution of caustic soda, and by subsequently testing it with recently prepared lime-water; the globules were now exposed to the solar focus from the lens mentioned volume 5, page 363. It was near noon, and the sky but very slightly dimmed by vapour; although they were in the focus for nearly half an hour, they did not melt, disappear, or alter their form; it appeared however, on examining the gas that they had given up part of their substance to the oxygen, for carbonic acid was formed which gave a decided precipitate with lime-water. Indeed when we consider that these globules had been formed in a heat vastly more intense, than that of the solar focus, we could not reasonably expect to melt them in this manner, and they are of a character so highly vitreous, that they must necessarily waste away very slowly, even when assailed by oxygen gas. In a long continued experiment, it is presumable, that they would be eventually dissipated, leaving only a residuum of iron. That they contain iron is manifest, from their being attracted by the magnet, and their colour is evidently owing to this metal. Plumbago, in its natural state, is not magnetic, but it readily becomes so, by being strongly heated, although without fusion, and even the powder obtained from a black lead crucible after enduring a strong furnace heat, is magnetic. It would be interesting to know, whether the limpid globules are also magnetic, but this trial I have not yet made.

I have already stated, that the white fume mentioned above, appears when points of charcoal are used. I have found that this matter collects in considerable quantities a little out of the focus of heat around the zinc pole, and occasionally exhibits the appearance of a frit of white enamel,

or looks a little like pumice stone, only, it has the whiteness of porcelain, graduating however into light grey, and other shades, as it recedes from the intense heat. In a few instances I obtained upon the charcoal, when this substance terminated *both* poles, distinct, limpid spheres, and at other times they adhered to the frit like beads on a string. Had we not been encouraged by the remarkable facts already stated, it would appear very extravagant to ask whether this white frit and these limpid spheres could arise from carbon, volatilized in a white state even from charcoal itself, and condensed in a form analagous to the diamond. The rigorous and obvious experiments necessary to determine this question, it is not now practicable for me to make, and I must in the mean time admit the *possibility* that alkaline, and earthy impurities may have contributed to the result.

In one instance contiguous to, but a little aside from the charcoal points, I obtained isolated dark coloured globules of melted charcoal, analogous to those of plumbago.

The opinion which I formerly stated as to the passage of a current from the copper to the zinc pole of the deflagrator, is in my view, fully confirmed. Indeed, with the protection of green glasses, my eyes are sufficiently strong, to enable me to look steadily at the flame, during the whole of an experiment, and I can distinctly observe matter in different forms passing to the zinc pole, and collecting there, just as we see dust, or other small bodies driven along by a common wind; there is also an obvious tremor, produced in the copper pole, when the instrument is in vigorous action, and we can perceive an evident vibration produced, as if, by the impulse of an elastic fluid striking against the opposite pole.

If, however, the opinion which you formerly suggested to me, and which is countenanced by many facts, that the poles of the deflagrator are reversed, the copper being positive and the zinc negative be correct, the phenomena, as it regards the course of the current, will accord, perfectly well, with the received electrical hypothesis.

The number of unmelted substances being now reduced to two, namely, the anthracite, and the diamond, you will readily suppose I did not neglect to make trial of them, as however, the diamond is an absolute nonconductor and the anthracite very little better, I cannot say I had any serious hopes of

success. I have made various attempts, which have failed, and after losing two diamonds, the fragments being thrown about with a strong decrepitation, I have desisted from the attempt, having, as I conceive, a more feasible project in view.

I trust you will not consider the details of the preceding pages, as being too minute, provided the subject appears to you as interesting as it does to me. The fusion of charcoal and of plumbago, is sufficiently remarkable, but the evident approximation of the material of these bodies towards the condition of diamond, from which they differ so remarkably in their physical properties, affords if I mistake not, a striking confirmation of some of our leading chemical doctrines.

I remain as ever your faithful friend and servant,
B. SILLIMAN.

ART. XXI.—*Experiments upon Diamond, Anthracite and Plumbago with the compound Blow Pipe, in a letter addressed to Prof. Robert Hare, M. D. by the Editor.*

Yale College, April 15, 1823.

My Dear Sir,

Having last year, caused to be constructed, an apparatus, capable of containing fifty-two gallons of gas, for the supply of your compound, or, oxy-hydrogen blow pipe, and capable of receiving a strong impulse from pressure, I have been intending as soon as practicable, to subject the diamond, and the anthracite to its intense heat. Although their being non-conductors, would be no impediment to the action of the blow pipe flame on them, still, obvious considerations have always made me consider the success of such experiments, as very doubtful. I allude of course, to the combustibility of these bodies, from which we might expect, that they would be dissipated by a flame, sustained by oxygen gas.

My first trials were made by placing small diamonds in a cavity in charcoal, but the support was, in every instance, so rapidly consumed, that the diamonds were speedily displaced, by the current of gas. I next made a chink in a peice of solid quick lime, and crowded the diamond into it; this proved a very good support, but the effulgence of light was so daz-

ling, that, although, through green glasses, I could steadily inspect the focus, it was impossible to distinguish the diamond, in the perfect solar brightness. This mode of conducting the experiment, proved, however, perfectly manageable, and a large dish, placed beneath, secured the diamonds from being lost, (an accident which I had more than once met with) when suddenly displaced by the current of gas; as however, the support was not combustible, it remained permanent, except that it was melted in the whole region of the flame, and covered with a perfect white enamel of vitreous lime. The experiments were frequently suspended, to examine the effect on the diamonds. They were found to be rapidly consumed, wasting so fast, that it was necessary in order to examine them, to remove them from the heat, at very short intervals. They exhibited however, marks of *incipient fusion*. My experiments were performed upon small wrought diamonds, on which there were numerous polished facets, presenting extremely sharp, and well defined solid edges and angles. These edges and angles were always rounded and generally obliterated. The whole surface of the diamond lost its continuity, and its lustre was much impaired; it exhibited innumerable very minute indentations, and intermediate and corresponding salient points; the whole presenting the appearance of having been superficially softened, and indented by the current of gas, or perhaps of having had its surface unequally removed, by the combustion. In various places, near the edges, the diamond was consumed, with deep indentations, and occasionally where a fragment had snapped off, by decrepitation, it disclosed a conchoidal fracture and a vitreous lustre. These results were nearly uniform, in various trials, and every thing seems to indicate that were the diamond a good conductor, it would be melted by the deflagrator, and were it incombustible, a globule would be obtained by the compound blow pipe.

In one experiment, in which I used a support of plumbago, there were some interesting varieties in the phenomena. The plumbago being a conductor, the light did not accumulate as it did when the support was lime, but permitted me distinctly to see the diamond through the whole experiment. It was consumed with great rapidity; a delicate halo of bluish light, clearly distinguishable from the blow pipe flame, hovered over it; the surface appeared as if softened, numer-

ous distinct but very minute scintillations were darted from it in every direction, and I could see the minute cavities and projections which I have mentioned, forming every instant. In this experiment I gave the diamond but one heat of about a minute, but on examining it with a magnifier, I was surprised to find, that only a very thin layer of the gem, not much thicker than writing paper remained, the rest having been burnt.*

I subjected the anthracite of Wilkesbarre, Penn. to similar trials, and by heating it very gradually, its decrepitation was obviated. It was consumed, with almost as much rapidity, as the diamond; but exhibited, during the action of the heat, an evident appearance of being superficially softened; I could also distinctly see, in the midst of the intense glare of light, very minute globules forming upon the surface. These when examined by a magnifier, proved to be perfectly white and limpid, and the whole surface of the anthracite exhibited, like the diamond, only with more distinctness, cavities and projections united by flowing lines, and covered with a black varnish, exactly like some of the volcanic slags and semi-vitrifications. The remark already made, respecting the diamond, appears to be equally applicable to the anthracite, i. e. that its want of conducting power, is the reason why it is not melted by the deflagrator, and its combustibility is the sole obstacle to its *complete* fusion by the compound blow-pipe.

I next subjected a parallelopiped of plumbago to the compound flame. It was consumed with considerable rapidity, but presented at the same time, numerous globules of melted matter, clearly distinguishable by the naked eye, and when the piece was afterwards examined, with a good glass, it was found richly adorned, with numerous perfectly white and transparent spheres, connected also by white lines of the same matter, covering the greater part of the surface, for the

* In Tilloch's Phil. Mag. for November 1821, Vol. 58, page 386, I observe the following notice by Mr. John Murray. "By repeatedly exposing a diamond to the action of the oxy-hydrogen blow-pipe in a nidus of *magnesia*, it became as black as charcoal, and split into fragments which displayed the *conchoidal* fracture.

It will be found, that this gem affixed in *magnesia* soon, flies off in minute fragments, exhibiting the impress of the *conchoidal* form.

In lately exposing the diamond fixed on a support of pipe-clay, to the ignited gas, I succeeded in completely *indenting* it:—examined it after the experiments, it exhibited proofs of having undergone *fusion*."

space of $\frac{1}{4}$ an inch at, and around the point, and presenting a beautiful contrast, with the plumbago beneath, like that of a white enamel upon a black ground.

In subsequent trials, upon pieces from various localities, foreign and domestic, (confined however to very pure specimens,) I obtained still more decided results; the white transparent globules became very numerous and as large as small shot; they scratched window glass—were tasteless—harsh when crushed between the teeth, and they were not magnetic. They very much resembled melted silice, and might be supposed to be derived from impurities in the plumbago, had not their appearance been uniform in the different varieties of that substance, whose analysis has never, I believe, presented any combined silice, and neither good magnifiers, nor friction of the powder between the fingers, could discover the slightest trace of any foreign substance in these specimens. Add to this, in different experiments, I obtained very numerous perfectly black globules, on the same pieces which afforded the white ones. In one instance they covered an inch in length, all around, many of them were as large as common shot; and they had all the lustre and brilliancy of the most perfect black enamel. Among them were observed, here and there, globules of the lighter coloured varieties. In one instance the entire end of the parallelopiped of plumbago was occupied by a single black globule. The dark ones were uniformly attracted by the magnet, and I think were rather more sensible to it than the plumbago which had been ignited but not melted. We know how easily, in substances containing iron, the magnetic susceptibility is changed by slight variations of temperature. I am aware, however, that the dark globules may contain more iron than the plumbago from which they were derived, as the combustion of part of the carbon, may have somewhat diminished the proportion of that substance. I find that the fusion of the plumbago by the compound blow-pipe is by no means difficult, and the instrument being in good order, good results may be anticipated with certainty. As the press is waiting while I write, it is not in my power to determine the nature of all of these various coloured globules, and particularly to ascertain whether the abundant white globules are owing to earths combined with the plumbago, or whether they are a different form

of carbon. If the former be true, it proves that no existing analysis of plumbago can be correct, and would still leave the remarkable white fume, so abundantly exhaled between the poles of the deflagrator, and so rapidly transferred from the copper to the zinc pole, entirely unaccounted for. I would add, that *for the mere fusion* of plumbago, the blow-pipe is much preferable to the deflagrator, but a variety of interesting phenomena in relation to both plumbago and charcoal are exhibited by the latter and not by the former.

Hoping that if these subjects have not already engaged your attention, they will speedily do so, I remain my dear Sir, as ever, your friend and servant.

B. SILLIMAN.

POSTSCRIPT, April 18. FUSION OF ANTHRACITE.

The anthracite of Rhode-Island is thought to be very pure. Dr. William Meade, (See Bruce's Journal, pa. 36) estimates its proportion of carbon at ninety-four per cent. This anthracite I have just succeeded in melting by the compound blow-pipe. It gives large brilliant black globules, not attractable by the magnet, but in other respects not to be distinguished from the dark globules of melted plumbago. The experiment was entirely successful in every trial, and the great number of the globules and their evident flow from, and connexion with, the entire mass, permitted no doubt as to their being really the melted anthracite.

The Kilkenny coal gave only white and transparent globules; but it seems rather difficult to impute this to impurities, since this anthracite is stated to contain ninety-seven per cent. of carbon.

I have exposed a diamond this afternoon to the solar focus in a jar of pure oxygen gas, but observed no signs of fusion, nor indeed did I expect it, but I wished to compare this old experiment with those related above.

The diamond is now the only substance which has not been perfectly melted.

I inserted a piece of plumbago into a cavity in quick lime, and succeeded in melting it down by the blow-pipe into two or three large globules, adhering into one mass, and occupying the cavity in the lime; these globules were limpid, and nothing remained of the original appearance of the plumbago except a few black points.

ART. XXII.—*Fluoric Acid of Gay Lussac, and its application to the etching of glass.*—EDITOR.

As we have not seen any notice, that this powerful acid has been obtained in this country, we will briefly mention, that we procured it in full strength, during the late winter, and comparing it with the account given in the memoir, in the "*Recherches Physico-Chimiques*," of Messrs. Gay Lussac and Thenard, observed with much satisfaction that its properties fully justify their statement; not that we think their researches or those of Sir. H. Davy, needed confirmation, but, notices of interesting facts by different persons especially in different countries are not without utility.

The leaden apparatus, recommended for procuring pure fluoric acid, we have found so liable to fusion, and besides the failure of the experiment, and the loss of the apparatus, the fumes are so noxious and even dangerous, that we were induced to resort to the use of vessels of pure silver. For this purpose, an alembic* was made of the capacity of 16 fluid ounces, with a head and tube of the capacity of two and a half, and the tube was made to fit accurately the mouth of a silver receiver of the capacity of three and a half ounces. The latter (see the apparatus represented at fig. 7, plate 10.) was made, in the form of a bottle, and furnished with a silver stopper, ground so as to fit air tight; it being intended to serve, both as a receiver, and a containing vessel, for the acid, thus obviating the necessity of transferring it into another vessel.

Two ounces of very pure fluor spar from Shawneetown were introduced into the alembic, and four ounces of sulphuric acid were added; there should be no excess of acid, lest it should attack the silver. The whole apparatus was placed under a flue; the receiver was kept cold by ice, and a few live coals being applied beneath the alembic, served to disengage the acid, which was condensed in the receiver, *without the aid of water.*

*The alembic was made thick and heavy, and furnished with a silver cap, so that it might be used without its head, as a large crucible.

The cost of the entire apparatus, alembic-head, tube, cap and receiver, was about sixty dollars.

An ebullition was soon heard in the alembic, and occasionally there was a puff of dense fluoric acid vapor, from the mouth of the receiver, which, to avoid explosion, was allowed to remain a little loose around the tube. We did not measure the acid which we obtained, but judged that it was about one ounce in quantity.

The fumes that occasionally broke out from the apparatus, instantly and powerfully corroded some articles of glass that were near by, and the contact of them with the skin or lungs, was most anxiously avoided. For this purpose, the hands were covered with very thick gloves, and the acid was never poured from the bottle, except under the flue.

Whenever the bottle was opened, a dense cloud of white vapor appeared, and when a drop of the acid was allowed to fall into water, it produced much the same commotion and noise as red hot iron; exciting great heat and ebullition. A few drops placed in a small concave copper dish, instantly inflamed potassium, which burnt with a bright light, and was immediately dissipated.

A drop of the acid, let fall into a dry wine-glass, or upon a dry glass plate, promptly corroded and dissolved the surface, with as much energy as that with which sulphuric acid acts on potash.

For the purpose of procuring an acid adapted to the purpose of etching on glass, the experiment was repeated, with this difference, that half an ounce of water was placed in the receiver. This acid however, proved too powerful for this purpose, as it corroded and destroyed the varnish* used to protect the glass. When it was diluted with three or four parts of water, it acted in the happiest manner. Plates of glass being properly prepared, with the composition of bees' wax and turpentine, and surrounded at the edge by a rim of the same substance, were perfectly etched in the course of a minute or two. The progress of the corrosion in the parts denuded by the graver, could be distinctly seen. The same portion of acid, by pouring it from one plate to another, served to etch several in succession; and indeed with

*The common engravers' varnish is very apt to be destroyed, even by a very weak acid; but we found that the varnish or mastick recommended by Gay Lussac and Thenard, made by melting together common turpentine and bees' wax, formed a perfect protection while the acid was of proper strength.

this active agent, even when largely diluted, it is necessary to be very much on our guard, lest the corrosion go too far, and attack the plain parts of the glass.

In this manner, the rich and beautiful picture, representing the Oto Council, as delineated in the atlas, illustrating the narrative of Major Long's expedition, was elegantly etched in two minutes.

We have, for a course of years, tried many experiments upon the etching of glass, by the fluoric acid *vapor*, and have usually succeeded more or less perfectly; but we can confidently recommend the *pure diluted acid*, as being entirely superior, in energy, neatness, and ease of management. Although the strong acid is violent and dangerous, in the extreme, and should be by no means allowed to touch the skin, either in the fluid or vaporous state, the diluted acid may be managed with ease and safety. Still, a pupil, who incautiously dropped some of the latter upon his hand, experienced inconvenience for six weeks—that period having elapsed before the sore was healed.

It is proper to remark, that whenever the acid was poured from the receiver, the latter was firmly grasped by tongs of a peculiar construction, in order to avoid the danger of having the liquid come in contact with the hand.

INTELLIGENCE AND MISCELLANIES.

I. DOMESTIC.

1. Vindication of Mr. Henry Seybert's claim to the discovery of fluoric acid in the condrodite, (Maclureite of Mr. Seybert, yellow mineral of Sparta, N. J.)

Philadelphia, Feb. 25, 1823.

Sir,

BUT for some erroneous statements in Mr. Nuttall's reply to my letter of the 11th November, 1822,* our Controversy might have terminated. I feel it, however, a duty to

*See Journal of Science and Arts, Vol. VI. p. 168, & seq.

correct these statements, and the more especially, as it will be done with the aid of facts that are important in the history of the mineral in question.

Mr. Nuttall says, "If I am called upon, *as you are aware*, by Mr. H. Seybert to say when and where, I had *heard* of the existence of Fluoric acid in the Brucite or Condrodite, I might refer him back to a period when he was too young to have been acquainted with even the name of Chemistry."* I put no such questions to that gentleman: on a former occasion he told us, that "the condrodite, or Brucite, almost peculiar to Sparta, discovered likewise by the celebrated Berzelius, in Finland, accompanied by gray Spinelle is (*according to an unpublished analysis which I made in 1820,*) a Silicate of Magnesia with an *accidental* portion of Fluoric acid and Iron."† Mr. Nuttall did not then refer to any analysis made prior to that which he pretended to have made; my protest was therefore *directly* against his being the discoverer of the fluoric acid in this mineral. From the fact contained in my letter, above referred to, Mr. Nuttall, *as far as concerns himself*, has been obliged to renounce every pretension, heretofore made by him, on that subject. Mr. Nuttall seems still disposed to believe, that the fluoric acid in this mineral is an *accidental* ingredient, and he attributes its presence to "the contiguity of slender veins of fluuate of lime to the masses of condrodite or Brucite near to Franklin furnace, at Sparta."‡ The fact, however, is that *Sparta* is six miles distant from Franklin furnace, and I do not know, that any one has hitherto announced that *fluuate* of lime, lies contiguous to the carbonate of lime in which the Maclureite at *Sparta* is imbedded. I found none of it when I examined that locality. What influence the fluuate of lime, at Franklin furnace, may have had in the composition of the *Sparta* mineral, I must leave to be determined by those who are more disposed than I am, to speculate on this subject. Again, if fluuate of lime had been found *contiguous* to the Maclureite of *Sparta*, what chemist would pretend, that the magnesia in the latter

*See Journal of Science and Arts, Vol. VI. p. 171.

†Ibid, Vol. V. p. 245.

‡Ibid, Vol. VI. p. 172.

would have decomposed the former, to combine with its fluoric acid. In support of this belief, Mr. Nuttall tells us, that this mineral has been found at West-Point, in New-York, and that it has been observed with idocrase and mica from Vesuvius: he then says, "in these no trace of fluoric acid has as yet been discovered." To obviate this seeming objection, I will ask Mr. Nuttall if he knows, that the constituents of the specimens from the localities which he has cited, have been ascertained. As far as my knowledge, extends, no chemist has yet analyzed them, and I confidently anticipate, that when they shall be examined they will all prove to be *fluo-silicates of magnesia*. Analogy authorises such anticipations. *If we even admit*, that no fluoric acid has yet been discovered in the cases cited by Mr. Nuttall, we are not thence to infer, that this acid does not exist there, because we know that, that acid escaped the notice of Berzelius, when he analyzed the condrodite, found in Finland, and that I afterwards detected it in that mineral, though no *fluato of lime* accompanied the specimen which I examined.*

In the next place Mr. Nuttall tells us, that the Sparta mineral "was announced by Professor Cleaveland in his *first* edition of Elements of Mineralogy under the name of *Brucite*." I am surprised at this assertion and will thank Mr. Nuttall, to point out the page in Cleaveland's *first* edition, where the word "*Brucite*" is imprinted. I maintain that it cannot be found in any part of that valuable work.

The term "*Brucite*" was announced, for the first time, in 1819 to be "a new species in mineralogy, discovered by the late Dr. Bruce. We hope to publish in the next number a description and analysis of it."† Notwithstanding the anxiety for an analysis of what some now pretend to be this mineral, none was published prior to mine, in 1822,‡ although eight numbers of Professor Silliman's Journal, appeared subsequently to its being mentioned in that work. I maintain, that Dr. Bruce considered the Sparta mineral, a *silico calcareous oxide of titanium*. For my proofs, I refer

*Journal of Science and Arts, Vol. V. p. 366.

†Ibid, Vol. I. p. 439.

‡Ibid, Vol. V. p. 336.

to the Mineralogical Journal of Dr. Bruce,† to Professor Cleaveland's works,‡ and the late illustrious Haüy.§ The last named philosopher has told us, that he received some specimens of this mineral from Doctor Bruce, with the information that it was a *Silico Calcareous Oxide of Titanium*, and that he, relying upon the Doctor's account of it, adopted the error, until it was removed by his own crystallographical investigation, and by Berzelius' account of the analysis which he made of it; he then considered it a *Silicate of Magnesia*,|| substituting one error for another. Such was the state of their knowledge, on the continent of Europe, concerning the composition of this mineral, at the close of 1821, and in Great-Britain, they had made no further progress concerning it in 1822.*

Notwithstanding the facts above referred to, Mr. Nuttall, in his reply, relates that Dr. Langstaff, of New-York, as long ago as 1811, analyzed the Sparta mineral, and he then gives the doctor's account of it as follows, viz. "it yielded about,

Silex	-	-	32	
Oxide of Iron	-	-	6	
Magnesia	-	-	51	
Water	-	-	2	and by abstraction,
Fluoric Acid	-	-	9	
				100

The reader will estimate the value and necessity of the word "about" in the foregoing statement, when the numbers given conduct us to so exact a result! Dr. Langstaff was a pupil in Dr. Bruce's Laboratory, and it is now asserted, that the above analysis was made there in 1811. Is it probable, if such had been the fact, that Dr. Bruce would have remained, until his decease, ignorant of it? or that, if he had known it, he would, several years thereaf-

†Bruce's American Mineralogical Journal, Vol. I. 239.

‡Cleaveland's Mineralogy, p. 158, first edition, 1818.

§Annales des Mines, Vol. VI. p. 527.

||Ibid.

*Journal of the Royal Institution of G. B. Vol. XII. p. 329.

ter, consider this mineral a *Silico Calcareous Oxide of Titanium*, and make a misstatement to Haüy? Can we suppose that Dr. Langstaff would have withheld this information until December, 1822, *eleven years* after he claims to have made the discovery? Why did he not add his analysis* to the short notice of the Brucite, when it was first announced in 1819? It was then named to the world, without an indication of any one of its *physical* or *chemical* characters; not a word was even said about the bed where nature had cast it! These gentlemen might with equal propriety claim any new substance containing fluoric acid and magnesia. Notwithstanding all their efforts, not one of them has cited a single experiment which he made with this mineral! When Mr. Nuttall first claimed the discovery of the fluoric acid, in the Sparta mineral, he at the same time said, that his results were confirmed by Dr. Torrey's experiments.† Why did he then neglect the more important one which he now urges in favor of Dr. Langstaff? he alone can account for the omission. In his late reply to me he says, that Dr. Torrey, *five years ago*, "also found the existence of fluoric acid, as well as the other ingredients mentioned in the analysis of Dr. Langstaff."‡ From these statements it would seem, that Dr. Langstaff, in 1811, made an analysis of the mineral from Sparta, and that his results were confirmed by Dr. Torrey in 1817; still the *Brucite* was introduced to the scientific world in 1819, only with its name, without character, and regardless of its birth-place! Now they even dispute who discovered this mineral. Whilst Dr. Bruce *lived*, that merit was given to him; but since the decease of that gentleman, his former pupil, Dr. Langstaff, claims the discovery for himself! This might be considered of no consequence to the question, did it not prove, how opinions concerning facts, that we supposed long ago well established, have been changed to answer temporary purposes.

When the name "*Brucite*" first occurred in the *Journal of Science and Arts*, I supposed it was intended to design-

*The annunciation of that mineral was made, not at the instance of Dr. Langstaff, but by the request of Col. Gibbs; the promised analysis was, however, never forwarded.—ED.

†*Journal of Arts and Science*, Vol. V. p. 245.

‡*Ibid*, Vol. VI. p. 172.

nate the *red oxide of zinc*, discovered near Sparta, and first analyzed by the late Dr. Bruce; there was great reason for this opinion, because we derived our knowledge of that new species from the labors of that gentleman. In conclusion it is presumed, that no new claimants will urge further pretensions, and I flatter myself, that the facts which have been stated will satisfy every candid reader. I have to express my regret for the necessity of this appeal, but, at the same time, hope you will consider it entitled to a place in the next number of the Journal.

With sentiments of regard and esteem,

your obedient servant,

H. SEYBERT.

2. *Abstract of the Proceedings of the Lyceum of Natural History, New-York.*

Mr. Pierce read some "observations on the Geology of the Catskill Mountains," (pub. in No. 9, of this Journal,) and presented a collection of minerals and fossils from the district described.

Dr. Van Rensselaer presented a perfect specimen of the *Cyperus papyrus*, collected by himself from the river Anapo, near Syracuse, in Sicily, accompanied by a paper illustrative of its natural history, and its uses in the arts.

Dr. Dyckman, in the name of Dr. Stevenson, presented a collection of Plants, and a box of minerals from France.

A letter was received from Mr. Pierce, announcing the discovery of a copious chalybeate spring near Litchfield.

Mr. Blunt presented some fine specimens of Zoophites from Bermuda.

A paper was read by Dr. Dekay on a new and beautiful species of *Sertularia*, from the bay of N. York, the *S. utricularis*, with the following specific characters. *S. caule simplici, vesiculis utricularibus diaphanis, ore stricto, margine nigro, &c.* it is nearest allied to the *S. cupressina*. By a letter since received from the celebrated Lamouroux, it appears he has adopted the name and description.

Mr. Emmet read a report on an ore of iron from the Highlands of N. York, which was referred to him for examination. It is a magnetic oxide of a granular texture, mixed with a substance resembling quartz in appearance, of

a yellowish white colour, and nearly opaque. This substance Mr. Emmett submitted to a number of experiments, and determined it to be a phosphate of lime. It is probably the cause of that property of iron, called *red-short*.

A note was received from Mrs. Mitchill, accompanying a valuable donation of Shells.

A paper from Mr. Jacob A. Vandenheuvel was read on the domestic origin of N. American Bees, and many interesting particulars of the Honey Bees of Guiana, S. America accompanied by a case containing twenty species, collected by himself. Pub. in No. VII, this Journal.

Dr. Akerly presented a suite of Potter's clay from different States.

Dr. Torrey presented specimens of plants collected by himself on Long-Island, among which were several new species of the *myriophyllum* and *Fuirena*.

Mr. Halsey presented a collection of plants from the vicinity of New-York.

The committee reported a new species of *Sphex carolina*, and another species of *Sphex* from parasitic chrysalids.

A letter was read from Mr. Prince, communicating the fact of a new chesnut produced by the intermixture of the *castanea vesca*, and the *castanea pumilla*. Specimens of the Hybrid were shown. Pub. in No. VII, this Journal.

Dr. Torrey presented a collection of plants made by himself in the Pine Barrens of New Jersey.

A letter was read from Mr. Schoolcraft containing observations of himself and others during the Exploring Expedition to the N. West, with a drawing of the Sand tree of Michigan, described in his Journal, since published.

A memoir on the cetaceous animals was read by Dr. DeKay. It would appear that out of twenty species belonging to this order, thirteen are found occasionally in our waters.

Col. Gibbs presented, through Dr. Torrey, some fine specimens of Iron ore, and of the corundum of Naxos.

A communication was received from Major Delafield with a valuable donation of minerals and organic remains, collected by him on the northern boundary of the U. S. The fossils and sulphates of Strontian are peculiarly beautiful.

President Mitchill communicated some interesting particulars of the *Xyphias Gladias*.

Dr. Van Rensselaer presented a collection of dried plants from the Alps of Savoy.

Mr. Anderson presented specimens of graphite from Pennsylvania and some pencils manufactured from the same, on which a committee reported favourably.

President Mitchill communicated a description of an animal brought by Mr. Schoolcraft from the regions situated around the sources of the Mississippi. It is a beautiful animal, and resembles the *Sciurus Striatus*, or ground squirrel. Dr. Mitchill terms it *S. tridecem lineatus*, or *Federation squirrel*, in allusion to its thirteen stripes and numerous spots. A detailed account has been published in the New-York Med. Repos. new series, Jan. 1821. The President at the same time exhibited a dried specimen of the *mus bursarius*, gopher or pouched rat, (brought by Capt. Douglass,) from Lake Superior, with some observations upon it. Pub. No. IX, this Journal.

A communication was received from Dr. Dekay, with a collection of minerals made by himself in France and Great Britain.

A letter was laid on the table from Mr. J. Blunt, accompanied by a bone of a Mastodon from Catskill Mountains.

Dr. Dekay communicated a description of a species of *Ophisaurus*, from the borders of Lake Michigan, brought thence by Capt. Douglas. It was conceived to be a new species and was named *O. Douglasii*.

Some remarks were read from President Mitchill on the *Proteus Anguinas* of Carniola and on the *Siren Lacertina* of Carolina, and a letter from Judge Woodward on the tides of Lake Erie.

A paper was read by President Mitchill on the *Coca* of Peru, *Erythroxylon Coca*, much used by the natives for food and medicine.

Mr. Schoolcraft presented some minerals and fresh water shells collected during the Exploring Expeditions to the N. West, under Gov. Cass. Mr. Barnes, from the committee on these shells, reported several new species and varieties, particularly of the genus *Unio*, and announced his determination of a more detailed report.

Collections of minerals from New South Shetland, and one of pumices from the same place was presented by Capt. Mackay and Capt. Johnson.

Dr. Torrey read a report on the ceraphron destructor, a parasitic animal that preys upon the cecidomyia destructor, and which has been supposed erroneously to be injurious to wheat.

A communication was received from Dr. S. P. Hildreth on a species of *Spatularia* from the Ohio, supposed to be new.

A valuable donation of Scientific books received from Mr. J. Eastburn.

President Mitchill presented a description and specimen of a new species of *Scomber*, which he named *S. quinque aculeatus*.

A donation was received from Dr. Hosack of a splendid copy of Wilson's Ornithology in 9 vols.

Mr. Barnes read an Essay on the Geology of the region around New Lebanon. Published in No. XI this Journal.

The Rev. Mr. Schaeffer read a paper on a fossil bone (head of the tibia) of a mammoth found in Lancaster Co. Penn. Ten large bones were found, but most of them were too much decomposed to be preserved.

Mr. Halsey read a paper on the cheirostemon pentadactylon of Humboldt.

Mr. Barnes read a paper on a new species of bivalve mollusca, found by Mr. J. Cozzens near New-Orleans, and which Mr. B. names *Mytilus Striatus*.

Dr. Torrey communicated a locality of cyanite, discovered on the island of New-York, by Mr. J. Cozzens. This mineral had not before been observed in the vicinity of New-York.

A drawing and description of the *Balenopterus acuto-rostratus* was presented by Dr. Dekay. This animal was taken off Sandy Hook, and exhibited as a curiosity in this city.

Mr. Barnes read an Essay on the Genera *Unio* and *Alasmodonta*. Pub. in No. XIII this Journal.

Dr. Van Rensselaer read an Analysis of Dr. J. W. Webster's Work on the Geology of the Azores, accompanied by Observations on the Lavas and Pumices of the Lipari Islands, in the Mediterranean.

Dr. Torrey read a description and analysis of a new mineral from Richmond Mass. It is nearly a pure Hydrate of Alumine, and is named Gibbsite, in honor of a distinguished American Mineralogist. Pub. in the New York Med. and Phys. Journal.

President Mitchill communicated an account of his dissection of the *Balenopterus acuto-rostratus* lately exhibited.

A communication was received from Dr. Beckwith accompanying specimens of the natural wall in North Carolina.

Dr. Torrey reported that a mineral from Hudson, N. Y. presented by Mr. Barnes, was a variety of Jade, called Nephrite. It much resembles the Nephrite of Rhode-Island, being infusible by the blow pipe.

Dr. Torrey read a memoir on the *Usnea fasciata*, a new cryptogamic plant from New South Shetland, with an accompanying letter from Dr. Mitchill. Pub. in No. XIII this Journal.

A communication was received from Major Delafield, detailing information of a gun of ancient construction found in the Chesapeake, covered with siliceous pebbles, forming puddingstone.

A valuable donation of books was received from Col. Gibbs, and another from Dr. Dekay.

The President read a communication on the progress of Natural History during the recess of the Lyceum since May last.

Mr. Barnes read a description of a new species of *Mytilus*, from New South Shetland, which he names *M. Antarcticus*.

Dr. Torrey communicated an account of a new locality of Stilbite and Laumonite. They occur in small crystals in a cellular felspar near cold spring in the Highlands of New York. The Stilbite was described in No. XII. The Laumonite is disseminated with the Stilbite, but is in much smaller quantity. It occurs in small white four sided prisms, nearly right-angled, with summits very obliquely truncated. The lateral planes are distinctly striated longitudinally.

Mr. J. Cozzens read a paper on the acid existing in the berries of the common sumac, (*Rhus glabrum*) detailing the experiments by which he has ascertained it to be *malic acid* in nearly a pure state.

Dr. Torrey laid on the table specimens to illustrate his intended paper on the minerals of Sparta, N. J.

A combination of unavoidable circumstances has prevented the earlier appearance of this abstract. It is intended to give a notice of the proceedings of the Lyceum, in each succeeding number of this Journal.

3. *Efficacy of Prussic Acid in Asthma.*

To the Editor.

From THOMAS HUBBARD, M. D. President of the Medical Society of Connecticut.

Sir,

By your politeness I was furnished, about three years since, with a vial of Prussic Acid, prepared by M. Robiquet, according to the directions of Dr. Magendie of Paris.

Since that time, I have made use of that, and several other portions of that medicine. The disease in which I have found it most useful is Asthma, and for the purpose of recommending trials of that medicine in this disease, I am induced to make this communication.

Without going into the detail of the cases, I barely state the fact, that I have not failed to relieve the disease in a single instance, in which I have prescribed the prussic acid, and some of the cases have been very severe, and many other means of relief had been tried in vain.

I do not think proper to mention the particular doses of the medicine, as it is found of unequal strength in the shops, and being a medicine of great power, it ought not to be administered without the direction of a physician. Suffice it to say, that the medicine should be given three, four, five, or six times in twenty-four hours, in such doses as may produce its peculiar effects, in some degree, on the system.

In a few days the symptoms will probably abate, when the medicine may be given in smaller or less frequent doses, and if the symptoms entirely disappear, the medicine may be wholly omitted.

I do not pretend that the disease may not recur; but in each subsequent occurrence, by an early administration of the medicine, the paroxysms may be abated in violence and duration, by which means the general health of the patient will in most cases improve.

This I consider of great consequence in such a distressing disease as this is, in some instances. I know a gentleman

who has usually kept it by him for two years, and resorts to it with as much confidence of relief, as a patient whose pains had been repeatedly relieved by opium, has recourse to that medicine.

Sometimes he has not had occasion to use the acid for three or four months in succession.

Pomfret, March 24, 1823.

4. *Notice of Dr. Beck's Gazetteer.*

(Communicated.)

"A Gazetteer of the States of Illinois and Missouri," 8vo. pp. 352. by Lewis C. Beck, A. M. has lately been published by C. R. & G. Webster, Albany. Dr. Beck is a Member of the New-York Historical Society, and has resided sometime in Missouri. By traversing a considerable portion of these States, by the aid of several intelligent gentlemen in them, by access to the records of the States, and by other means, Dr. B. had accumulated a mass of materials which he has formed into this work, and which make it very valuable to the citizens and travellers, and very interesting to all who desire information respecting this important section of our country. The Gazetteer contains a "general view of each State—a general view of their counties—and a particular description of their towns, villages, rivers, &c. &c." It is accompanied by a map, "protracted from manuscript surveys, obtained at St. Louis and Vandalia," which appears to have been formed with great care. There are also several other engravings, illustrative of the descriptions of particular objects. The "general view" of each State embraces those particulars which belong naturally to Geography, as well as antiquities, land districts, history, minerals, &c. The botanical names of the principal genera of plants in Missouri, and of the trees of Illinois, are also given, and will be relied on by all who know the success of Dr. B. in the science of Botany. A Gazetteer must of necessity be, to a certain extent a compilation; but the reader will find abundant proof of Dr. B.'s diligence, research, and originality. The arrangement would perhaps be improved by placing all the towns, &c. in both States, in one alphabetical arrangement instead of two. The work is

well composed and neatly printed, and deserves the patronage of the public. The article, *Military Bounty Tract*, p. 128, and p. 291, contains much very important information to the settlers, and those who propose to remove to these States. The articles, *Pike County*, *Fort Chartres*, *Fort Dearborn*, *Monk Mound*, and *Vandalia*, under Illinois; and *Fenton*, *Noyer Creek*, *St. Louis*, *Strawberry River*, under Missouri, are particularly interesting.

On page sixteen, the length of the Ohio River is stated to be one thousand one hundred miles, but the true length is, by actual measurement, according to Mr. Darby*, nine hundred and forty-eight miles.

On p. thirteen, is a correction of a mistake in Mr. Schoolcraft's "Narrative Journal," which was repeated in the *North-American Review*, No. 36, respecting the average descent of the Mississippi. Mr. S. states the elevation of the source of the Mississippi to be one thousand three hundred and thirty feet about the tide water of the Hudson, and the length of the river, three thousand and thirty miles. This would give an average descent of nearly forty-four hundredths of a foot, or about five and a quarter inches a mile. This is a far less descent than is given either by Mr. S. or the Reviewer. This mistake was early pointed out to the latter, and is too considerable not to merit attention, especially as this descent is to account for the rapid current of the Mississippi, whose velocity is generally estimated from three to four miles, and by Dr. Beck, from two to four miles an hour. The velocity acquired in falling, without resistance, through five and a quarter inches, is about one foot and a half a second, and would be the velocity of the river, if there were no resistance. Allowing this to be the mean velocity of the river, it would be only one mile and one forty-fourth an hour. But considering the resistance from the bends, sand-banks, counter-currents, &c. it cannot be supposed that, with only this descent a mile, the velocity can be more than one mile an hour. Mr. Darby thinks that the velocity of the current has been much overstated, and that "below the Ohio the entire mass does not move as much as one mile an hour,"—that even the velocity of the upper current is much less than has been generally stated. He also estimates the descent of the Mississippi

*Art. Mississippi River, in the *New Edinb. Encyc.*

below the Ohio, at only three and a half inches a mile, which would produce, were there no resistance, a velocity of only eighty-five hundredths of a mile an hour. He also estimates the elevation of the source of the Mississippi* to be less than that given by Mr. Schoolcraft; and, if the tide water of the Hudson is lower than the waters of the Gulf of Mexico, the descent of the Mississippi must be proportionally diminished. It seems pretty evident that the allowed velocity of the river is too great for the estimated descent. It is certain, at least, that a more accurate determination of the velocity of the current, as well as of the elevation of the source of the Mississippi, is very desirable; and it is to be hoped that the remarks in Dr. Beck's Gazetteer will lead some of the western gentlemen to a satisfactory result on one or both of these particulars. D.

5. Dr. Comstock's Grammar of Chemistry.

In the fifth volume of this Journal, the publication of this work was mentioned. We by no means hold ourselves responsible to give opinions of new works, but we owed the respectable author of this manual, good-will enough to have said a few words on the merits of his book, had it not been postponed from *mere inability to peruse it*.

If our opinion be of any consequence in this case, we are gratified in saying that Dr. Comstock has executed his work with very creditable ability and address. It is concise, perspicuous and select, and bears strong internal evidence of being the offspring, to a great extent, of a *practical man*, who writes with the precision which can be derived from experience alone. Those chemical compilations which are made by men who have never performed what they describe, resemble the fictitious travels of imaginary adventurers, who delineate countries which they have not seen. In chemistry, the *audivi* may give a man many good ideas, useful to himself; the *vidi* will still more enlarge his knowledge—but it is only the *feci* which qualifies him to instruct others. Dr. Comstock's experiments are well chosen, well-described, and made intelligible and *practicable* by wood cuts inserted in the pages of the work.†—Ed.

* Art. *Navigation Inland*, in the New Ed. Encyc.

†Perhaps it is a mark of his good judgment and prudence that he has omitted.
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6. Mineral Caoutchouc.

This remarkable mineral, hitherto nearly or quite confined to the Owdin mine at Castleton, in Derbyshire, has been recently found at Southbury, twenty miles N. W. of New-Haven. This region is a secondary trap basin (see Vol. II pa. 231 of this Journal) and although only six or eight miles in diameter, it presents all the characteristics of the great trap region of Connecticut and Massachusetts described by Mr. Hitchcock. Among other things, it contains slaty rocks with bituminous minerals; these have induced a research for coal which is now going on. We understand that they find bituminous slate or shale with small veins of coal. Specimens confirming this statement are now on the table, and they exhibit fibrous limestone, forming very distinct veins, or rather layers, running parallel with, and lying between those of the slate. The fibres of the satin spar or fibrous limestone, are one inch and more in length; they are often cracked in the direction of the fibres and between them there are veins occupied by the mineral caoutchouc. It has but little elasticity, it is soft, easily impressible by the nail, and compressible between the fingers like potassium, and can be formed into a perfect ball; its colour is jet black; some varieties of it are a little harder, and have a resinous and splendid lustre, and a flat conchoidal fracture; it burns with extreme brilliancy with much black smoke and an odour between that of a bitumen and that of an aromatic; during the combustion, drops of liquid fire fall in a stream, or in quick succession, and with a whizzing noise exactly like the vegetable caoutchouc and it melts precisely as that substance does. Rubbed on paper it leaves a black streak and acquires a high polish, it does not remove pencil marks from paper. The veins containing this mineral are about one quarter of an inch wide and several inches long.—*Ed.*

April 10, 1823.

ted to describe the most dangerous fulminating preparations, lest his readers should incur injury from attempting the experiments. There are a few typographical errors; the most important which we observed is, that hydrogen stands as the basis of nitric acid, (p. 21.) We do not observe any table of errata. This little work cannot fail to be very useful in schools, and to private experimenters, and contains a great deal in a small compass.

7. *Hudson Marble.*

The territories of the United States are rich in marbles, well adapted by their beauty and firmness, to architectural and sepulchral and other ornamental, as well as useful purposes. We have omitted as yet to mention one which is wrought by Mr. Charles Darling at Hudson, and is obtained from the vicinity of that town. We did not see this marble *in place*, but no geologist would hesitate on inspecting it, to refer it to the transition class, and indeed Hudson is in the midst of that strip of transition country, which Mr. Maclure designates in his geological map, along both sides of the Hudson.

This marble is of a greyish colour, with a slight blush of red; its structure is semi-crystalline and in some places highly crystalline, especially in and around the organized bodies, which, in vast numbers, it embraces. Among them, the encrinite, is very conspicuous, and frequent, and when the marble is polished, the organized bodies, congealed in a bright calcareous bed, and often more brilliant themselves than the medium in which they are fixed, give it a very fine effect; this is particularly true in large slabs, which present great diversity of appearance and could scarcely be distinguished from the similar transition marble of the Peak of Derbyshire which it greatly resembles, and quite equals in beauty and firmness.—*Ed.*

8. *Thermometers.*

We have observed with satisfaction, the progressive improvement in this country, in the manufacture of glass in its most important branches, and especially of thermometers, so indispensable to all researches on heat, and to many arts, depending on its laws. Mr. Fisher of Philadelphia, Mr. Pool of New-York, and Mr. Pollock of Boston, (besides probably others not within our knowledge or recollection) are advantageously known to the public, as manufacturers of thermometers, and of various articles, of philosophical apparatus. Their situation, in our principal cities, gives them facilities for being known, and for introducing their articles to the public approbation which they have justly obtained.

Perhaps it is not generally known, that in one of our villages, excellent thermometers, of every variety of construction, may be obtained. They are the work of a self taught artist, Mr. Thomas Kendall Jr. of New Lebanon, whose ingenious device for graduating tubes of unequal bore, is mentioned at pa. 398, Vol. 4, of this Journal.* We have several of Mr. Kendall's thermometers, constructed for particular purposes, and with which, as regards both the neatness and accuracy of their execution, we have every reason to be well satisfied. Some of them are particularly convenient, as they are constructed with naked balls, and with the contiguous part of the tube descending below the scale, which fits them for immersion in liquids, at the same time that they are conveniently packed in travelling cases, and will answer well for chemical, medical, and meteorological observations.

We are assured that upon Mr. Kendall's plan of graduation, if the bore of a tube is of a regular *taper*, there is no more difficulty in making a correct thermometer of it (even if it varies so much, that the space necessary for three degrees at one end makes but two at the other,) than of one that is uniform throughout.

The substance of Mr. Kendall's improvement, we understand to be, a method of dividing right lines into any number of parallel divisions, with equal ease and accuracy, whether equal or unequal: applicable to the manufacture of mathematical instruments, but more particularly to the graduation of thermometer scales, which almost universally require unequal divisions. This method may also be applied to the division of circles, and would be of great use to the artist in manufacturing machinery which required a great number and variety of cogs, as with an engine constructed on this principle, one number would be as easily obtained as another.—*Ed.*

9. *Salem Manufacture of Alum, &c.*

We contemplate with particular satisfaction, every advance made in our domestic arts and manufactures, and re-

* It will not diminish the value of that notice, if we mention, that it was written by the late Professor Fisher, after mature consideration of the subject.

gard every new step of this kind, as an addition to our national resources.

Excepting the natural alum of the caverns in Tennessee and of some other regions of the West and South, and that, occasionally found, in our schistose rocks, and used in these cases, more or less, for domestic dyeing, and other purposes, we were not aware that the United States possessed any resource for this article independent of the foreign markets.

Some time since, we were informed that a manufactory was established at Salem in Massachusetts, and the proprietors have recently put us in possession of a set of specimens, which prove that the effort has been completely successful.

Among the crystals of alum, are some of great size, and exquisite beauty and transparency, exhibiting to the naked eye, in a very striking manner, the successive layers of superposition and the progressive increments and decrements. A part of an octaedron lies before us, complete, except on the side where it adhered to the mass. It measures nearly five inches by four, and has the most perfect finish on its faces, and solid edges and angles, which are in every part, replaced by truncations. Some crystals of rather smaller size are quite or nearly perfect. We are aware that fine crystals of alum are not rare in manufactories, but we have not seen these equalled even by the similar productions of the celebrated establishment near Glasgow. There can be no question from the appearance of these crystals, as well as from that of the amorphous masses, of the extreme purity of these materials. Perhaps they are even purer for this reason, that the alum is not manufactured (as we understand,) from the usual source, namely, the decomposed alum slates, but from the direct synthetic union of sulphuric acid with the argillaceous earth.

The sulphate of copper, (blue vitriol,) made at this establishment, is equally perfect in its kind, presenting crystals of extreme finish and beauty.

The skill manifested in the manufacture of these articles, clearly evinces, that the persons conducting this establishment, are quite equal to the task which they have undertaken, and are fairly entitled to the public confidence.—*Ed.*

10. Geological Survey on the Great Canal.

The patroon of Albany, the Hon. Stephen Van Rensselaer, with his usual liberality, has undertaken the expense of

procuring a Geological survey, to be made of the whole region, contiguous to the great canal, and of all the interesting tracts in its vicinity, extending from Albany to the Falls of Niagara. For this purpose, he has employed Professor Amos Eaton, with the aid of several assistants, and their task is already advantageously commenced. Mr. Eaton is well known to the public as an active, industrious, and faithful observer, and we look to a happy issue of this great enterprise, which we trust will be honourable to all concerned.—*Ed.*

11. *Expedition of Major Long and party, to the Rocky Mountains.*

We have recently perused, with great satisfaction, the narrative of the expedition of Major Long and party to the Rocky Mountains, by order of the government of the United States. This narrative is contained in two large octavo volumes, illustrated by an atlas with maps, geological sections, and perspective views. The happy and successful execution of this arduous enterprise reflects equal honor upon the government who patronized, and upon the gentlemen concerned in the expedition.

Their commission included the geographical and physical features of the country, the details of Botany, Zoology, Geology and Mineralogy, the condition of the native tribes, the climate, and in short every thing which could be interesting, either to science or politics. This difficult task was most ably and faithfully executed, and if it were consistent with the design or limits of this work to attempt an analysis of the volumes in question, we should find the task very difficult, because it is scarcely possible to abridge the interesting and important details with which they abound.

A successful generalization may indeed be exhibited, with respect to the geological features of the country; but it would be unhappy to exhibit the subject in a state less perfect than that which it assumes in the narrative itself.

We perused with no small regret the account of the vast sandy desert which, for the distance of five hundred miles from the feet of the Rocky Mountains, presents a frightful waste, scarcely less formidable to men and animals, than the desert of Zahara; and we contemplated with admira-

tion and sympathy, the toils and sufferings and perils, encountered by the adventurers, who, on more than one occasion were near starvation, or on the point of being overwhelmed by hordes of barbarians.—*Ed.*

12. *Philadelphia Water Works.*

This fine city is now abundantly supplied with good water, from the Schuylkill, and a magnificent establishment for that purpose is completed at Fair Mount, five miles above the city at the falls of the Schuylkill. The entire expense including the purchase of the scite is \$426,330, but the money appears to have been well bestowed, as the success of the experiment is complete. The river at the falls is about nine hundred feet wide; the depth at high water is thirty feet; its average rise and fall is six feet, and it is liable to sudden and violent freshets. "The whole length of the overfall is one thousand two hundred and four feet, and the whole extent of the dam including the western pier about one thousand six hundred feet," backing the water up the river about six miles.

The water power created, is calculated to be equal to raise into the reservoir by eight wheels and pumps, upwards of ten millions of gallons per diem. The river, in the dry season, will afford four hundred and forty millions every twenty-four hours;—and as it is calculated, that forty gallons upon the wheel will raise *one* into the reservoir—eleven million of gallons may be raised each day.

Many interesting particulars, detailed in the last report of the watering committee,* which is illustrated by a large copper plate sheet, exhibiting a plan and perspective, we must omit—and proceed to state, that the machinery in actual operation, is able to raise upwards of four millions of gallons in twenty-four hours into the reservoir, which is of such an elevation as to afford the hydrostatic pressure of ninety-two feet, throwing upon the pumps a pressure of seven thousand nine hundred pounds. There are two reservoirs, one of which is one hundred and thirty-nine feet by three hundred and sixteen, and twelve feet deep, having the capacity of three millions of gallons; It is connected with another reservoir which contains four millions of gallons. The water being raised into these, one hundred

* Forwarded by the kindness of Mr. George Vaux.

and two feet above low tide, and fifty-six above the highest ground in the city ; is thence conveyed in the iron pipes described in our last Number, (page 173,) the whole extent of which is now thirty-five thousand two hundred and five feet, "and in no instance has a leak been discovered." The greater part of the pipes now laid are of American manufacture, none ever having been imported except as samples.

The system obviously admits of indefinite extension. The committee justly remark that "the uses and importance of this water, it is impossible sufficiently to value. The additional cleanliness of the city, (which with the suburbs contains between 120,000 and 130,000 people,) the supply of the neighboring districts for culinary purposes, as well as for purposes of refreshment—the great advantage in case of fire—the ornament of fountains in the public squares so wisely provided by our great founder—the benefit to manufactures, and the establishment of water power in the city for various purposes, may be named among the advantages of this new work ; but above all we are to place its effect upon the health of a great and growing community, which of itself would justify a much greater expenditure."—*Ed.*

13. *Test for Platinum.*

In the course of various trials, with hydriodic acid, upon metallic solutions, we were recently much impressed with its remarkable effect upon the muriate of platinum. If dropped into a solution of this salt, even when extremely dilute, it produces, almost immediately, (and *immediately* if the solution be of only moderate strength) a deep wine red, or reddish brown colour ; by standing a few minutes, it grows much more intense, and becomes very striking, after the lapse of ten minutes. It much resembles the effect of the recent muriate of tin, but is a more delicate test than that, as it produces decided results where that gives but a faint change of colour. By standing a day or two, the solution becomes covered on the top, and on the sides of the vessel, with a film of perfectly metallic platinum. From this circumstance, it appears that the test operates by reducing the solution to the metallic state. Perhaps this effect was favoured by the manner in which the hydriodic acid

was prepared. It was done by putting phosphorus to about an equal bulk of iodine placed under water, in a glass tube; an immediate action ensued consisting, apparently, in the decomposition of water—oxygen being thus imparted to the phosphorus and hydrogen to the iodine. The hydriodic acid, thus formed, of course remained mixed with phosphoric acid, containing perhaps an excess of phosphorus. I did not make the trial with the pure hydriodic acid, and cannot positively say what agency the phosphorus might have had, in producing this effect. Even if the phosphorus should prove to be essential, perhaps the observation may be still worthy of being preserved. No other metallic solution gave similar results.—*Editor.*

14. *American Geological Society.*

From its munificent President William Maclure, Esq. the society has recently received a box of the lavas of Vesuvius—Beudant's Geological travels in Hungary 4 volumes with maps—a continuation of the *Revue Encyclopedique*, and of the *Journal de Physique*—Conybeare and Philips' *Geology of England*, and a case of the *Glauberite of Spain*.

Major Delafield has presented to the society a box of minerals consisting principally of the boulder stones found on the shores of the upper lakes, but embracing also various domestic and foreign specimens.

15. *On Animal Fat.*

Stearine and Elaine.

[Communicated by Professor Eaton.]

AN intelligent tallow-chandler, Mr. W. Parmelee of Lansingburgh, informed me, a few days since, that the tallow of beeves, which are slaughtered during, or at the close of the hot season, makes much harder candles, than of those which are kept until the weather becomes cold. This fact, he said, had always been known to tallow-chandlers; but he gave a reason for this difference, which I believe you will think worthy of scientific investigation.

Mr. P. had not noticed the distinction made by chemists between the olive-oil-like part, called *elaine*, which lique-

fies at 60° Fahrenheit, and the hard part, called *stearine*, which remains solid at 100° Fahrenheit. But he had separated the two substances, and re-combined them in various ways. Without any chemical analysis, he had compared the *elaine* of tallow with the sweat of cattle, and found a great resemblance in their sensible qualities; though the latter contained a larger proportion of water and of muriate of soda. From these observations he infers: that during the hot part of the season, when cattle sweat profusely, such a large proportion of the *elaine* is evacuated through their skins, that the *stearine* is left in a much larger proportion than that which is found in their tallow after the sweating season has passed.

With Mr. P.'s permission, I communicate these observations, in the hope that some American chemist, who has sufficient leisure, will compare the results of an accurate analysis of the *elaine* and sweat of beeves. It may throw some light upon the science of animal economy, and of the proximate principles of animal matter.

Troy, N. Y. Jan. 13, 1823.

16. *Additional Notice on the Fused Carbonaceous Bodies.*

If melted charcoal, plumbago and anthracite do really approximate towards the character of diamond, we ought to expect that, in consequence of fusion, there would be a diminution of conducting power, with respect both to heat and to electricity. This I find to be the fact. As soon as the point of charcoal is fused by the deflagrator, the power of the instrument is very much impeded by it; but as soon as the melted portion is removed, the remaining charcoal conducts as well as before; and so on, for any number of repetitions of the experiment, with the same pieces of charcoal.

The globules of melted plumbago are absolute non-conductors, as strictly so as the diamond. This fact is very pleasingly exhibited, when a point of prepared charcoal, connected with the zinc pole of the deflagrator, is made to touch a globule of *melted* plumbago, however small, still adhering to a parallelopiped of plumbago, in its natural state, screwed into the vice connected with the copper pole; not the minutest spark will pass; but if the charcoal point be moved,

ever so little aside, so as to touch the plumbago in its common state, or even that which has been ignited, without being fused, a vivid spark will instantly pass. This fact is the more remarkable, because it is equally true of the intensely black globules which are sensibly magnetic, and therefore contain iron, as of the light colored and limpid ones, which are not attractable.

The globules of melted anthracite are also perfect non-conductors. This may appear the less remarkable, because the anthracite itself is scarcely a conductor; at least, this is the common opinion, and it certainly is strictly true, of that of Wilkesbarre and of that of Kilkenny; for, when both poles are tipped with those substances, there is only a minute spark, which is but little augmented when charcoal terminates one of the poles. But the fact is remarkably the reverse with the *Rhode-Island* anthracite; *this* conducts quite as well as plumbago, and I think even better, giving a very intense light, and bright scintillations. I have now no doubt, that the deflagrator will melt it, but have not had time to complete the trial.

If it should be said that the conducting power of the R. I. anthracite may be owing to iron, we are only the more embarrassed to account for the fact, that its black melted globules are insensible to the magnet, and are perfect non-conductors.

It will now probably not be deemed extravagant, if we conclude that our melted carbonaceous substances approximate very nearly to the condition of diamond.—*Ed.*

April 23, 1823.

17. *New Journal*.—The first No. of the Boston Journal of Philosophy and the Arts will be published in the month of May.

18. *Ittro Cerite*.—Col. Gibbs has discovered the Ittro Cerite at Franklin in New-Jersey.

II. FOREIGN.

1. *Stereotype Edition of Newton's Principia*.—A very elegant stereotype edition of the "*Principia*"* has made its appearance from the University Press at Glasgow, conduct-

*Of which a copy is now in our hands.

ed by Messrs. Andrew and John M. Duncan. It is a reprint of what has been known by the name of the "Jesuit's edition of the Principia," first published at Rome by two learned French ecclesiastics, Thomas Le Seur and Francis Jacquier; and embracing their celebrated commentary. The objects of this commentary are, as explained by the authors themselves, "to throw light upon such parts of the work as are difficult or obscure; fully to demonstrate those truths which Newton has announced, but neglected the proof; and to bring into clearer view some of the less obvious beauties that abound in the demonstrations."

The authors of the commentary have enriched their work with occasional treatises, taken from the writings of distinguished men, on various subjects, both mathematical and physical; as, the tract on the Conic Sections—a concise, but elegant specimen of geometrical reasoning, which appears to be the production of a professor at Geneva; and the well-known essays of Bernoulli, Euler and M'Claurin, on the motions that prevail in the waters of the globe. To these are added dissertations on the general principles of Mechanics, and the elements of the fluxionary calculus; together with many of the observations, experiments and reasonings of philosophers, both before and since the days of Newton. Solutions also, of ingenious and useful problems often recur.

Perhaps it is the chief fault of the work, that its authors have too carefully attempted to explain every point that seemed in the least degree obscure, and thus increased its bulk, without adding proportionally to its value. The present edition is published in the Latin, and comprises four handsome octavo volumes.

When the value of the Principia and the scarcity of former editions are considered, this must be deemed an important addition to the list of new publications; and the influence which original works of this high character always exert upon the progress of useful science, renders it desirable that, if introduced into this country, the work may meet with encouragement equal to its merits.

2. *Travels in America*.—J. M. Duncan, A. B., of the University Press, Glasgow, author of "A Sabbath among the Tuscarora Indians," is preparing for publication an

account of Travels through part of the United States and Canada, in 1818 and 1819, intended chiefly to illustrate subjects connected with the Moral, Literary, and Religious condition of the country.

Those who enjoyed the pleasure of Mr. Duncan's acquaintance, while travelling in this country, will expect much from his intelligence and candor, and we confidently believe they will not be disappointed.—*Ed.*

3. *Fossil Vegetables*.—We have received from Mr. Adolphus Brongniart of Paris, a work "*Sur la classification et la distribution des Végétaux Fossiles*"—illustrated by lithographic plates. It is an elaborate and valuable work and an analytical notice of it by Dr. J. G. Percival will appear in our next number.—*Editor.*

Communicated by Dr. Jeremiah Van Rensselaer.

4. *Fresh water formations*.—From the new edition of Cuvier's work on Organic Remains, it appears that the fresh water formations of Paris and Rome are precisely similar : presenting the following order of succession from below upwards.

1. A compact limestone analogous to the Jura limestone, or even perhaps to chalk—rarely containing petrifications.

2. The coarse sandstone formation, composed at its lowest part of bluish argillaceous marl, with shells, and towards its upper part of reddish sandy limestone, and sometimes of marine sandstone.

3. The volcanic breccia, in all its modifications, lying above this formation.

4. The fresh water formation.

Messrs. Brongniart and Brocchi, who have examined together these formations, conclude that there are two kinds of fresh water formations, very distinguishable by external characters, which indicate their difference of origin. The one produced by solution and precipitation, more or less pure and crystalline, has issued from the interior of the earth with the waters which have carried them to the surface of the soil. They may be formed at all elevations where similar waters may have issued, and the height at

which they occur is not always a proof of that to which the fresh water has been elevated. These are the most extensive.

The *other*, of a coarser texture, resulting from the abrasion and washing of the surface of the rock, is formed by means of sediment at the bottom of still waters into which they have been carried. They are much less diffused, less pure, and may contain remains of marine bodies. A part of the Limagne of Auvergne, the fresh water formation of the Swiss Molasse, and probably the plastic clays and lignites are of this formation.

5. *New Atmometer*.—Mr. Anderson, of Scotland, has invented a new Atmometer, or *Evaporometer*, for measuring the evaporation from water, in any given time. It is said to be superior to those heretofore invented by Mr. Leslie, and to equal in simplicity and accuracy the method employed by Mr. Dalton to discover the evaporation from the ground.

6. *Turquois and Lazulite*.—Berzelius announces the ca-laite or Turquois to be composed of phosphate of alumina, phosphate of lime, silica, oxide of iron, and oxide of copper. The Lazulite is a compound of phosphate of alumina, phosphate of manganese, and of phosphate of iron and oxide of iron.

7. *Translation on Natural History*.—Mr. J. S. Miller has published a prospectus of his intended translation of the "*Natural History* of Alcyonia, Spongia, Corallina, Sertularia, Eschara, and Corals, from the French of Lamarck." Mr. Miller is well known by his work of the Crinoidea.

8. *West or Lost Greenland*.—The indefatigable Capt. Scoresby is about publishing his discoveries on the coast of West Greenland. Since the setting in of the Polar ice in 1406, the fate of near 300 villages or plantations, with 16 churches, 2 convents, &c., has remained in obscurity, as all attempts to reach the coast have been unavailing. The perseverance of Capt. Scoresby, however, has enabled him to land several times in different places, in nearly all of

which he discovered traces of inhabitants, but saw no people. He was within two hundred miles of the presumed site of the lost colony. He has accurately surveyed the coast from lat. 75° to 69° including nearly 800 geographical miles of the indented coast. He finds an error in the position of the land in lat. 74° , as laid down in charts, of about 15° , or 900 miles of longitude. In August 1821 he found the weather oppressively hot, and the air swarmed with bees, butterflies and musquitoes. The coast was highly picturesque, but it was seldom that the ice allowed him to approach nearer than 15 leagues from the shore.

Ed. Philos. Jour. Jan. 1823.

9. *On the limits of the occurrence of Fishes in high situations.*—According to Raymond, the only fishes that occur in the waters of the Pyrenees, at heights of from 1000 to 1162 toises are *Salmo trutta*, *S. Fario* and *S. Alpinus*. Higher up all fishes disappear. The water Salamander ceases to live at the height of 1292 toises; probably because the higher lakes are half the year frozen. But cold is not the sole cause of the disappearance of fishes in high altitudes, since Humboldt mentions that in the equatorial regions of America, where the mean temperature of the freezing point begins 1500 toises higher than in the Pyrenees, the fishes disappear earlier in lakes and rivers. No Trouts occur in the Andes. At a height of 1400 or 1500 toises there still occur *Pocilien*, *Pimelodes*, and the very remarkable new form *Evemophilus* and *Astroblepus*. Under the equator, from 1800 to 1900 toises, where the mean temperature is still $+9^{\circ} 5'$ cent., and where few lakes ever freeze, fishes are no longer met with, with the exception of the remarkable *Pymelodes Cyclopum*, which are thrown out in thousands with the clay-mud, projected from fissures in the rocks, at the height of 2500 toises. These fishes live in subterranean lakes.—*Id.*

10. *Iodine.*—After the beneficial results obtained by Dr. Coindet, from the use of Iodine in the cure of Goitre, the Clinical Institute of the Royal University of Padua, have used it with a view of different effects. They detail the cases of persons submitted to its action, and conclude

that Iodine, besides its being endowed with the property of increasing vascular action, restoring sanguification and re-establishing the ordinary sanguineous excretions, particularly from the uterine vascular system, on which it would seem to exercise a direct action, excites the activity of the gastric functions, so that under its use the appetite is renewed and active, the work of digestion goes on with celerity and without inconvenience even in delicate females, and those with weak stomachs.—*Lon. Med. and Phys. Jour.*

Articles of Foreign Literature and Science, extracted and translated by
Professor GRISCOM.

11. *Preservation of Anatomical Preparations.*—Dr. Macartney of the University of Dublin employs for his anatomical preparations a solution of alum and nitre, which he finds, has the property of preserving natural appearances much better than spirits of wine, or any other fluid hitherto employed. The proportion of the two salts, and the strength of the solution must vary according to circumstances; and in order wholly to impregnate the preparations the solution should be renewed from time to time. This solution is so highly antiseptic, that it destroys entirely, in a few days the fetor of the most putrid animal substances.

12. *A Chain Bridge* is in a state of forwardness, over the *Menai* an arm of the Irish Sea which separates Anglesea from N. Wales. It will have the unprecedented length of 560 feet, between the two supports, one on each shore; and its height above the water will be 126 feet, so that vessels may pass beneath it under full sail. The abutments are of masonry, surmounted by wood pyramids 50 feet high, over which the chains pass. The bridge is 28 feet wide containing a foot path of four feet wide in the middle. It will cost £70,000 sterling.

13. *Vegetable Analysis.*—Dobereiner describes in his *Phytochimie pneumatique* a little apparatus very convenient for obtaining vegetable extract, through the medium of water, alcohol, ether, &c. from 10 to 200 grains. It consists of a glass tube A of 4, 6 or 9 lines in diameters, and from 4

to 9 inches long destined to receive the substance to be acted upon by the solvent. It is closed at bottom by a cork *a, a*, (see pl. 10, fig. 5,) through which passes the small tube *b, b*, open at each end, except that it is covered with muslin at *x* to prevent the pulverised substance from passing into it. One half of the tube *A* is filled with the vegetable powder, and the other half with the fluid. The small tube is adapted by means of a cork to the small globe *B*, freed from air by a few drops of alcohol, which by the application of heat expands into vapour and expels the air. The small tube is then tightly pressed into its neck, and the apparatus is set in a cool place. As the alcoholic vapour contracts and then forms a vacuum, the pressure of the air forces the liquor through the pulverised mass and thence into the globe. In a few minutes a portion of extract is thus obtained, which being withdrawn, the vacuum may be renewed by alcohol, and the process thus continued at pleasure.

14. *A Steam Boat* either has been, or is about to be constructed on the Lake of Geneva in Switzerland by our countryman Edward Church; who was the first to bring steam navigation into successful operation in France by the establishment of a steam boat on the Garonne. The Swiss boat, (the first, it is believed, yet attempted in that romantic country) will ply between Geneva and Lausanne, stopping a few minutes at Copet, Niou, Rolle and Morges, and perhaps extending her voyage occasionally to Vevey and the Chateau de Chillon. A more picturesque and delightful navigation can scarcely be conceived.

15. *Vesuvius*.—By a letter from Naples dated November 5th, 1822, published in the Bib. Univ. of Geneva for the same month, it appears that the eruption of Vesuvius which took place on the 22d of October was as terrific as any that has occurred since A. D. 79 described by Pliny. Day was turned into night by the clouds of ashes and other volcanic matter, which at a distance from the mountain, fell to the depth of 5 and 6 feet. The writer collected several pounds of the ashes from his Balcony in Naples. It was at first of a reddish brown, and then more white, and appeared to him like pulverised pumice stone. He states that it had been analysed by M. Pépé who found in it sulphate of potash,

sulphate of soda, of lime and magnesia, sub. sulphate of alumine; hydro-chlorate of potash and of soda. much oxide of alluminum, of calcium, of silicium, and of magnesium, much tritoxide of iron and of antimony, and a little gold and silver. The writer thinks that this result strengthens the hypothesis. which ascribes volcanic fire and explosion to the infiltration of sea water to masses of potassium, sodium, and other metallic bases.

16. *The Mean Temperature* of the climate at Salem Mass. and at Rome in Italy, nearly in the same latitude, was for the 33 years, ending in 1818 as follows :

		Lat.	Temp.	
Rome,	- . .	41° 53'	60° 44'	Far.
Salem,	- . .	42° 33'	48° 68'	
		Diff.	11° 76'	

17. *Skeletons of the Mammoth and Elephant* have been recently discovered in the district of Hontes in Hungary.

18. *Academy of Inscriptions and Belles Lettres at Paris.*—A literary fête, the first of this kind in France, was celebrated on the first of April last, at the termination of the general session of the Institute. The members of this Academy united at a banquet around their venerable perpetual secretary M. Dacier, the Nestor of letters and of French erudition, to celebrate at the same time, his 50th Academic year, the 42d of his perpetual secretaryship, the 80th of his age, and his happy convalescence after a serious indisposition, which had much alarmed his numerous friends. This union was a true family feast, each of its members offering the homage of his affectionate wishes to the worthy chief who for half a century has been charged with the interests of literature, and who has conducted the concerns of the Academy with as much honor to that body as advantage to letters and solid studies.

19. *City of Odessa.*—This city which in 1792 consisted of only a few hovels, now contains 40,000 inhabitants, Rus-

sian, German, French, Greeks, Jews, Americans, and Poles. It contains a French and Italian theatre; a lyceum founded by the duke de Richelieu, which affords numerous advantages; schools of law, navigation, commerce, &c. eight churches, two thousand houses and numerous public buildings. In summer, Odessa is visited by a great number of families from the north of Russia and Poland, for the purpose of sea bathing. The population of the suburbs is continually increasing.

20. *The Greek Seminary* founded at St. Petersburg in 1775 by Catharine II, acquires every day, fresh importance. It educates about 200 young Greek and Albanian officers. There are 25 professors. But, besides military science, the French, Italian, and German languages are taught. When the students have finished their course, they may choose either the station of an officer, the place of interpreter in the colleges of St. Petersburg or Moscow, or a return to their own country. There are now in the Seminary many young people from Scio, Lesbos and Naxos.

21. *A House of Refuge* was founded in the month of April 1817 in the Rue Grès Saint Jacques at Paris, and has been ever since supported by charitable donations, for the purpose of receiving from the prisons, those juvenile offenders whose good conduct while in confinement, may entitle them to this favour. The Refuge is placed under the immediate direction of a person who generously offered to devote himself to this work of mercy. The boys are taught in six work shops directed by skilful masters. Cabinet makers, shoe makers, joiners, tinmen, painters on metal, workers in bronze, are here in full activity. The exposition which is annually made at St. Louis of the products of these children's labour, proves their rapid progress and improvement. An experience of five years leaves no doubt of the success of the institution. Since 1817, one hundred and eighteen children have been received from the prisons. Their conduct has responded to the solicitude of those who have not ceased to watch over them. If a few among them who have deceived the expectations of the administration, have been sent back to the authority, the greater number have justified

them. Twenty-one young people have been restored to the society in a condition to provide for themselves, and even to assist their parents. To render more certain the perseverance of those who annually leave the refuge, the administration gives them a protector selected from among its own members. This protector watches over his pupil, informs himself of his conduct, of his work, of his wants, and of his success. During five years, those discharged pupils, may, if they are worthy of it, receive pecuniary assistance from the house. Every month, the council distributes rewards to the best workmen, and at St. Louis, utensils and other useful things are given to the children, who have distinguished themselves by their good behaviour, docility, and love of labour. A multitude of children are exposed in the prisons to all sorts of danger. Resources are wanting to extricate these unfortunate creatures from that melancholy indolence, and corrupting example to which they are exposed.

22. *Conservatory of Arts and Trades*.—M. Charles Dupin, member of the Academy of Sciences, terminated on the 9th of June, the course of Mechanics applied to the Arts, of which he is professor in this fine establishment, by giving a summary of the objects of which he has treated this year. He exhibited a table of the ameliorations which the mechanic arts may produce in the most important branches of our industry. We remark particularly that which regards the application to the means of transport, upon the highways, and the services rendered by the steam engine, and those which French industry may expect to derive from it. We recognize in these considerations, the learned engineer, who has written upon the maritime arts, and upon navigation by steam. We cannot too earnestly invite the directors of mechanical concerns, whether in Paris or in the departments, to send their children and their foremen, to attend the course which is annually given at the Conservatory, commencing in the month of November.

23. *Sugar from Beets*.—Extract of a letter addressed to the Editor of the "*Revue Encyclopedique*."

The good of France, the prosperity of our native soil, is what occupies incessantly every noble mind. I seek among the libraries, and journals, every thing that relates to na-

tional character and public utility, and I attend very assiduously the discussion of the Chamber in order to inform myself, by the light which is often there thrown upon objects of the greatest interest. I listened with extreme impatience to the discussion of the law relative to the tariff, because I foresaw that sugar would certainly be the grand war horse, against which, the lances of the strongest combatants* would be broken. All that I could there collect which amounted to demonstration, is that France consumes one hundred millions pounds of sugar; that our colonies produced in 1821, forty-four millions kilogrammes, and that the surplus is drawn from foreign countries. This consumption proves that of the whole of Europe must exceed six hundred millions of pounds of sugar annually, and that in adding to this the value of the rum made from the molasses of this same sugar, it results that the new world, raises for this single object, an annual impost of six hundred millions of francs upon ancient Europe. Disgusted at not hearing in this solemn discussion a single word relative to the richest discovery of the age, the fabrication of European sugar, I opened the eighth number of *Annales Europeennes*, and I there found a statement which demonstrates with mathematical evidence, 1st. that the sugar of beets, is made with the same facility as bread. 2d. That this sugar may be easily obtained, of a quality superior to that of the finest American sugars. 3d. That France may not only fabricate enough for its own consumption, but that it might dispose of perhaps a hundred millions to its neighbours. 4th. That this would be the means of employing very happily more than a million of poor persons, of producing a harvest upon many millions of acres left unemployed, of fattening annually a hundred thousand cattle; in short, of realizing new treasures in favour of France, and of producing a great extension of comforts in every class of the nation.

I could say much more upon this important subject, as well as upon many others of the same kind, but if you have the goodness to admit this letter into your Journal, I shall make it a duty to add something hereafter.

24. *Statistics of Egypt.*—Every traveller in Egypt attributes to the Vice Roy, all the qualities of a statesman.

(*In the MS. competents.)

The christians who live under his laws are under many obligations to him; and enterprizing travellers of all nations and religions may now traverse Egypt with a security before unknown in the Ottoman dominions. The army of the Vice Roy consists of not less than 45,000 men, comprehending infantry, cavalry and artillery. His naval force is composed of 22 vessels, and the navigation of the Nile is protected by a great number of gun boats, each of which carries 40 men. The revenues of Mohamet Ali, as Vice Roy, amounts to 25 millions of Spanish piastres. They arise from custom house duties, taxes, tolls, fisheries, public domains, contributions from conquered countries, and from caravans, &c. The Vice Roy pays in title of vassal 2,400,000 livres to the Sultan; he sends the same sum to the Treasury of Mecca; 800,000 measures of rice, &c. to Constantinople, furnishes provisions to the caravans of Cairo; keeps a brilliant court, and often sends presents to the Sultan, to the favourite Sultana as well as to the ministers of his highness and to persons in credit at the Seraglio. The actual population of Egypt does not exceed 3,000,000. It contains 2,496 towns and villages, of which 957 are in Upper Egypt, and 1,539 in the Delta.

25. *Poland*.—Nathan Rosenfeld, a Jew merchant at Warsaw, a very learned man, has recently published a history of Poland, written in Hebrew. This new historian has examined the best sources of information, and has left nothing to be desired with respect to the authenticity or arrangement of his facts.

26. *Copenhagen*.—M. H. Faber who has been three years in Iceland, and has examined every portion of that mountainous island, has formed an ample collection of its birds and their eggs, which is now in the Royal Museum. He has recently published in Latin a preliminary notice of his discoveries under the title of a Prodruma of Icelandic Ornithology.

27. *Fine Arts*.—Albert, duke of Saxe-Teschen, has left to one of the princes of the imperial family his rich collection, consisting of 300,000 engravings, from the earliest essays in this art, to the most finished modern productions;

82,000 portraits, and more than 40,000 original designs. This collection is one of the finest and most considerable in Europe.

28. *Calligraphy*.—Gov. Frederick Spang, has exhibited in his house at Augsburg a collection of 550 specimens of elegant penmanship of the late Abbey Werner. They consist of models of all the different kinds of writing; choice reflections from the best writers in French, German, Italian, English, Latin, Greek and Hebrew; representations of artificial objects, portraits of sovereigns, philosophers, and celebrated men, all wrought simply with pen and ink.

29. *Switzerland. Canton of Argovia*.—The grand council of our Canton, decreed last year the establishment of a *normal school for the formation of school-masters*, destined not only for those who may desire to embrace that profession, but also to furnish the means of perfecting those who have already entered the career of public instruction. A sum of 6000 Swiss livres (about 1,780 dollars) has been appropriated which will provide for the appointment of professors, and afford also the means of instruction. The pupils, the number of whom is not to exceed 30, must possess on entering, the knowledge usually acquired in the primary schools. This instruction will continue two years, and will embrace the German language, arithmetic, geometry, natural history in its relations to rural economy, to the mechanic arts, and to the daily wants of life; geography, national history, music and drawing. Particular attention will be paid to the religious and moral instruction of the pupils, who will also be alternately exercised in giving instruction in the different branches of knowledge.

30. *Abau*.—*The Society* formed a few years since in this town, for furnishing instruction during the winter months, to the young people of the Canton over eighteen years of age, continued last winter its course of gratuitous instruction with complete success. The subjects treated of in this course, were the history of the Swiss confederacy, combined with modern history; physical geography; the principles of natural law; geometry; mineralogy; and the fundamental principles of mechanics. The pupils have been

exercised in linear drawing; as well as in compositions in the German language. Those who wish to profit by this instruction, are at liberty to choose the course which they will follow, under the condition however that they are to remain at least three months.

31. *Canton of Geneva. Society of the friends of the fine arts.*—Of all the tastes which spring from that luxury which is inseparable from an advanced state of civilization, there is none which affords a pleasure more pure and more durable, than that which is inspired by those arts which in delighting the eye by their brilliant productions, recall places and facts, the recollection of which interests us, or of persons who are dear to us. These mild enjoyments are not the only fruits which we derive from the culture of the fine arts; they contribute at all times to the prosperity of cities, and the glory of their people. The most direct means of favouring them is to encourage artists and increase the number of amateurs. Such is the design of the Society, "*Des amis des Beaux Arts*," which has just been formed at Geneva, in imitation of those which have for some years existed at Zurich, as well as in many of the large cities of France. By means of these establishments, those things become of easy attainment which would be onerous or even impossible to individuals. It is to this noble spirit of union and joint labour that the city of Geneva is indebted for the greater number of its institutions. We may even say that to this it owes its existence as a Republic. The first general meeting of the society of fine arts, took place on the 17th of May last. A committee of ten managers was appointed and bye laws established for its government. The society consists of stockholders, each of whom take what number of shares he thinks proper. Each share costs \$5 annually. The funds of the society will be employed nearly in the following proportion. 1st: Three fourths of the income after the payment of incidental expences are applied to the purchase of pictures, designs, and sculptures, the original work of living Swiss artists. 2d. The other fourth is expended in engravings. The articles thus acquired will be sufficient in number to be divided by lot among the stockholders at the rate of one lot to every ten shares. Every share not favoured by the lot, will have

a right to a proof of each of the plates purchased by the society in the course of the year. The objects of art, acquired by the society will be exposed to view, before the drawing of the lots. Although the society is in its infancy the number of shares subscribed for already, amounts to 150. A number of distinguished foreigners have taken shares.

32. *Wire Drawing*.—The common method of drawing cylindrical wire, consists in forcing the metal through circular openings in plates of iron, steel, or some other metal; but it is soon observable, that the whole gets worn or deformed, and that the wire then ceases to have the desired regularity. Mr. Brookedon of London has nearly remedied this inconvenience by passing the metallic thread through conical holes made in diamonds, sapphires, rubies, or other hard gems. It appears to be unimportant whether the wire be introduced at the large or the small opening of the conical hole, but the best results, upon the whole, are obtained when the wire is entered by the smaller base, and drawn through the larger one.

33. *Hops*.—The valuable discovery of Dr. Ives of New-York, on the powder of the Hop, as announced in his memoir, published in volume II. p. 302 of this Journal, has excited considerable attention in Europe. M. M. Payen and Chevalier, two French chemists, have made some researches upon the yellow powder (the Lupulin of Dr. Ives,) which they consider as composing one tenth of the hop. They recognize in it the following principles.

Essential Oil, about	-	-	-	.02
Sub. Acetate of Ammonia	-	-	-	-
Gum	-	-	-	-
Malate of Lime	-	-	-	-
A bitter principle	-	-	-	.125
A well characterised resin	-	-	-	.525
Silex	-	-	-	.040
Traces of a fatty matter, and some salts.				

We limit ourselves (say the editors of the *Annales de Chimie*,) to a statement of these results, without any other

detail of the proceedings which furnished them, because if, on the other hand, we consider them as sufficient to excite the interest of chemists in a plant so eminently useful as the hop; on the other, the various labors which we have cited, still leave much to be desired.

34. *Electro-Magnetism*.—M. Assiot, Professor of Natural Philosophy at Toulouse, states an instance in which, during a heavy thunder-storm in that city, on the 22d of June last, a metallic tube that extended from the top of the house to a well or cistern, served as the channel of a heavy discharge of the electric current. The tube was much rent, and other damage sustained by the house, which was a small one, and contained fourteen or fifteen persons, none of whom were injured. The magnetic effects of the stroke were the most remarkable. A spike which the fluid met in its way, was sufficiently magnetised to lift a table knife, and was used in magnetising other things. A tailor's boy, at the moment of the explosion, was smoking his pipe, with the back of his chair leaning against a post near the conducting tube; he experienced no disturbance, but was greatly surprised on the next Monday, in taking his needle-case out of his pocket, to find that the needles were so magnetised that seven or eight of them would hang together in a chain. Another case, placed on the chimney, twenty feet from the tube, and containing five needles, was also strongly magnetised. M. Assiot says that he shewed those good tailors who brought him their needles, that two or three discharges from a single jar through a wire wrapt spirally round a tube, would produce the same effects upon the needles it contained, and that evidently without their forming part of the current.

35. *Velocity of Sound*.—A very careful experiment was made on the 21st and 22d of June last, at Paris, by order of the Board of Longitude, in order to solve this problem with greater precision than heretofore. The experimenters were Humboldt, Gay Lussac, Bouvard, Prony, Mathieu and Arago. The former three stationed themselves at Montlhery, and the latter three at Ville-Juif, two situations distant from each other, by the most careful geographic measurements, 9549.6 toises. The experiments were performed in the night, by means of two six pounders, one at each station,

charged with from two to three pounds of powder. The number of seconds which elapsed between the flash and the sound, was noted by chronometers furnished by Breguets, one of which denoted even the sixtieth of a second.

A singular fact in the course of the experiments was, that the firing was distinctly heard at Ville-Juif, by all the gentlemen, without difficulty, while at the other station not one half the sounds were audible. Very little wind prevailed, and what there was, was in favor of the persons stationed at Montlhery. The reporters do not undertake to explain the cause of this difference; for, say they, we can only offer to the reader, conjectures void of proof. The result of their trials, after all due allowances, is, that at the temperature of 50° F. the velocity of sound is 173.01 toises, 337.2 metres, 1106.3026 English feet per second.

36. *Steel*.—The Society of Encouragement at Paris, has decreed a gold medal to M. Pradier, who has brought his steel instruments to the highest degree of perfection. He has discovered the valuable art of rendering steel very hard, and at the same elastic. His steel blades can be bent double, and are yet so hard as to cut *iron*, without any injury whatever to the edge, however fine and thin it may be. This operation was many times repeated by M. Pradier, in presence of the committee, and always with success.

37. *Sal-Ammoniac*.—By the accidental combustion of a bed of coal in a mine near St. Etienne in France, in a situation where it could not be extinguished, there is exhaled, in addition to the usual products of the combustion of coal a vapour which becomes condensed on the adjacent substances, in the form of a white salt. It was considered by the country people as salt-petre, and some of the physicians supposed it to be alum. But from experiments made in the laboratory of the school of mines it proved to be very pure sal-ammoniac, (hydro-chlorate of ammonia.) During a few dry days the ground becomes covered with an efflorescence of this salt, and it continues to increase till dissolved by rain. In the interior of an uninhabited house, are found those fine specimens which now make a show in some cabinets. During the years 1818 and 1819, the production

of this salt was so abundant, that several pieces detached from the walls of the house weighed near a kilogramme, 2½lb. With proper attention, the collection of it might certainly be rendered lucrative. Whence proceeds the hydro-chloric acid of this ammoniacal salt? This question it does not seem easy to resolve; but one thing is certain, all the water of the coal pits of St. Etienne contains among other salts a notable quantity of hydro-chlorates with earthy bases.

38. *Vaporisation of Ether*.—Cagniard de la Tour has shewn by experiment that Ether is susceptible of being reduced to vapour in a space less than double its primitive volume, and alcohol in less than three times its volume. In these cases the former exerts a pressure equal to 37 or 38 atmospheres, and the latter, a pressure equal to 119 atmospheres. To effect such a vaporisation ether must be heated to 320° F. and alcohol to 405° F.

39. *Paper Hangings*.—To guard against the effect of dampness in the injury and destruction of paper hangings, a method has been adopted in London which proves to be very effectual. Very thin sheets of Lead are fastened to the walls by copper tacks, and to this the paper is pasted without any difficulty. The lead is as thin as the sheet used in the lining of tea boxes, and effectually excludes the moisture of the wall.

40. *Brick-making*.—A patent or privilege has been obtained at St. Petersburg for a press for making bricks, which is not only to diminish the labor, but to perfect the forms of the bricks. By means of this machine, not only bricks, both solid and hollow can be made, but tubes straight or crooked, cornices, flutes for columns and other architectural ornaments. The patentee is a M. Chomas who proposes to establish a model brickyard with improved ovens for baking the bricks. Three or four men can produce, it is said, with this machine from 10 to 12 thousand bricks, daily, of different forms.

41. *Leipsic*.—The number of students attached to the University of Leipsic, during the last winter session was 1102, of whom 480 applied themselves particularly to the-

ology, 381 to jurisprudence, 163 to medicine, and 74 to philology.

42. *Composition of meteoric stones.*—The presence of Nickel, as one of the ingredients of aerolites, has been so generally ascertained, that it is considered almost as an essential or invariable characteristic. Laugier, however, has given an analysis of the large stone which fell at Juvenas on the 15th June, 1821, in which he states the entire absence of Nickel, and the existence of a portion of chrome. One hundred parts of the stone afforded

Silex,	-	-	-	-	-	40.
Oxide of Iron,	-	-	-	-	-	23.5
Oxide of manganese,	-	-	-	-	-	6.5
Alumine,	-	-	-	-	-	10.4
Lime,	-	-	-	-	-	9.2
Chrome,	-	-	-	-	-	1.
Magnesia,	-	-	-	-	-	.8
Sulphur,	-	-	-	-	-	.5
Potash,	-	-	-	-	-	.2
Copper,	-	-	-	-	-	.1
Unavoidable loss,	-	-	-	-	-	3.0
Loss not accounted for	-	-	-	-	-	4.8
						100.00

A previous analysis of a meteoric stone which fell at Jonzac the 13th June 1819, afforded this able chemist the same results and confirmed him in the accuracy of his examination. Vauquelin, also, who examined the aerolite of Juvenas discovered no nickel, but recognized the existence of chrome, as well as the other ingredients, stated by Laugier.

The complete absence of nickel, and the almost entire disappearance of sulphur and magnesia, replaced by an abundant quantity of lime and alumine, establish between these two meteoric stones and those which have been previously known, a very marked difference.

Another example of the non existence of nickel occurs in a stone which fell in Finland, on the 13th of December, 1813, analysed by Nordenskiöld, a pupil of Berzelius.

43. *Preservation from rust.*—It has been ascertained by Arthur Aikin, secretary to the Society of arts and manufactures, that melted Caoutchouc is an excellent material for the above purpose. Plates of iron and steel, half covered with this substance, were exposed six weeks in a laboratory, and at the end of this time the uncovered parts were almost entirely corroded, while the varnished parts were completely preserved.

Caoutchouc must be melted in a close vessel. It requires about the same temperature for fusion as lead. When melted it must be stirred by a horizontal agitator, the handle of which rises through the cover, to prevent its being burnt at the bottom.

Mr. Perkins has perfected this process, by dissolving the caoutchouc in spirits of turpentine. The varnish thus obtained, after being suitably dried, becomes firm and does not change by exposure to moisture. It is laid on with a soft brush, and may be removed at any time by dipping the brush in hot spirits of turpentine. Mr. Perkins uses this varnish to preserve his engraved steel plates.

44. *Geology.*—There is found in the northern provinces of Russia, besides the bones of the mammoth and some other remarkable objects of natural history, a kind of fossil wood, in part petrified, and in part decomposed or rotten.

Professor Kounizin remarks that he formerly entertained the popular opinion that these trees had been blown down and gradually covered with sand and mud in or near the places where they grew. But he is now convinced that this is an error, and that they must have had an origin, quite remote from their present situation. For 1st. They are covered to a great depth with earth, in the form of beds parallel to the surface. 2d. All the trees have their tops directed toward the same quarter, and they are only inclined. 3d. Almost all have been broken by an irresistible force, the oaks alone retaining their roots. 4th. The bed of earth under which they are found is so thick that the waters of the rivers do not reach them. This earth is partly sand and partly clay. The trees that are covered with dry sand are quite rotten and moulder speedily into dust. Those under moist sand are still in good preservation. The pines and firs are more decomposed than the others, but

the species can be easily recognized by their position, their bark, the form of their fruits, seeds, and capsules. In the argillaceous soils, the trees are much better preserved, especially where the ground is moist, and it is in these cases that they are often found petrified. It is singular that trees which lie along side of each other are not equally well preserved; and there are some petrified at one extremity and still tender at the other. The oaks which are not petrified, are susceptible of being split into staves, and the country people convert them into axle trees, and cabinet makers employ them on account of their hardness. A remarkable fact is, that these oaks are found in a country where none at present grow, and which has been cleared from time immemorial. It would be very interesting to discover the epoch in which these trees were buried, and by what events they were overthrown and buried. Perhaps it was by the same force that transported so many blocks of granite in the north of Russia—and perhaps at the same time in which the entire race of the mammoth was annihilated, animals which might have had their abode in these sombre forests. The tops of the trees are inclined either towards the south east or south west, and consequently the force which destroyed them must have come from north to south.

These fossil trees are found in the whole of northern Russia, not only near rivers, but at a very considerable distance from their borders.

45. *Cooking Apparatus.*—Thenard & Fourier made a very favorable report, on the 26th of August last, to the French Institute, relative to a new boiler (*nouveau calefacteur*) invented by Lemare. It appears to consist of a bottom or grate which contains charcoal, and from which the heated air ascends into the space between two concentric cylinders both of which contain water. The water in each vessel is heated at the same time, and that in the interior vessel, being surrounded by another vessel of hot water will retain its elevated temperature a great length of time. By means of a damper, the combustion of the charcoal can be regulated at pleasure. The current of hot air can also be intercepted or left free as necessity requires. The exterior vessel has but three small openings. One at the top for pouring in water, one at the bottom with a cock for draw-

ing it off, and another, for which the first may easily be substituted, for receiving a bent tube which conveys the steam out of doors. The exterior vessel does not rise higher than the interior, but it descends lower and rests upon the grate.

From an experiment of the reporters, one part of charcoal is sufficient to vaporize 9.42 parts of water from the freezing point. Now, according to theory, charcoal can evaporate only 10.8 times its own weight of water, hence it appears, that, taking into consideration the heat communicated to the vessels themselves, the actual loss of heat is only $\frac{1}{18}$ which is very trifling.

The superiority of this instrument for culinary purposes, especially for soups, vegetables, &c. is attested by these scientific reporters, who assert that they intend habitually to use it, as it is attended with an economy of time, and fuel, an improvement in the quality of the food, and a certainty of success.

46. *Salt Petre*.—M. Baffi, an able chemist, born at Pergola, has received from the Vice Roy of Egypt, a present of 100,000 crowns, and the title of Bey, for having discovered a method of making salt-petre by the sun's heat alone, without the aid of fire. Before this discovery every cwt. of salt-petre cost the Vice Roy ten crowns, an expense which is reduced by the new method to one crown. The manufactory erected by M. Baffi on the great plain of Memphis furnished last year, to the Egyptian army, 3,580,000 lbs. of salt-petre.

47. Dr. Brewster has published (in the *Trans. of the Cambridge Philos. Soc.*) an interesting paper on certain peculiarities in the structure and optical properties of the Brazilian topaz illustrated by colored figures:—also (in the *Trans. of the R. Soc. of Edin.*) a description and drawings of a Monochromatic lamp with remarks on the absorption of the prismatic rays, by coloured media—also an account of the native hydrate of Magnesia discovered by Dr. Hibbert in Shetland, and, in a separate pamphlet, additional observations on the connexion between the primitive forms of minerals and the number of their axes of double refraction. Dr. Brewster's researches on the optical properties of minerals continue to present very extraordinary results.

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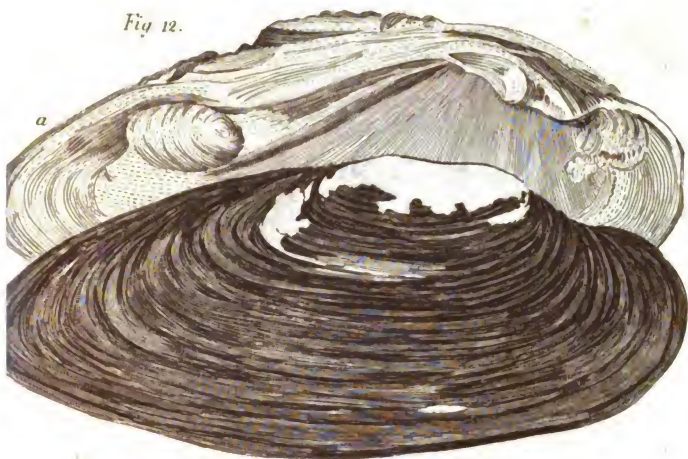
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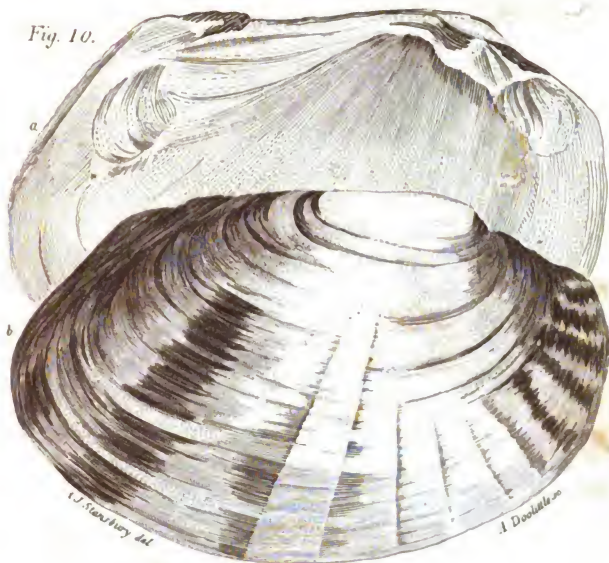
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Fig. 12.



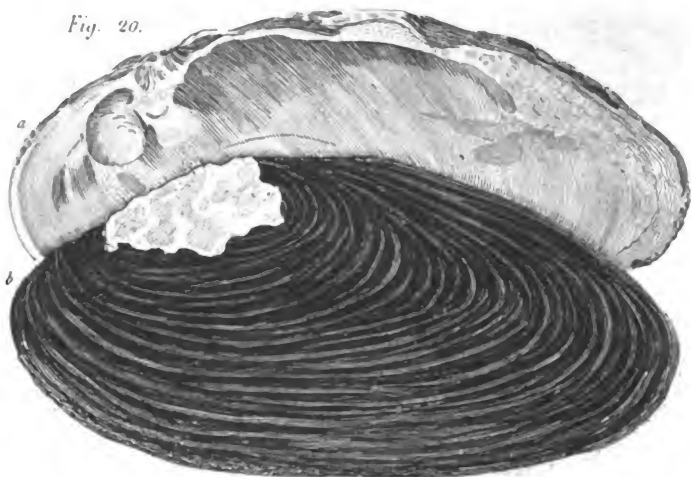
Unio Gibbosus.

Fig. 10.



Unio Carinatus

Fig. 20.



Asmodonta Arcuata (young)

Fig. 20.



Asmodonta Arcuata (old)

A. J. Stanbury del.

A. Donnell sc.

Durham Rocking Stone
pa. 248

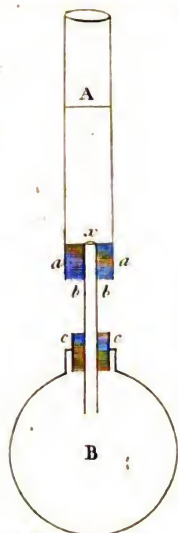
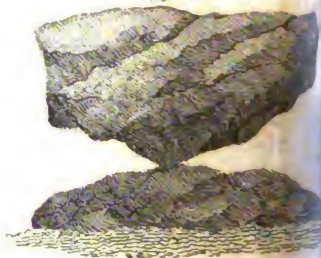
Fig 1.



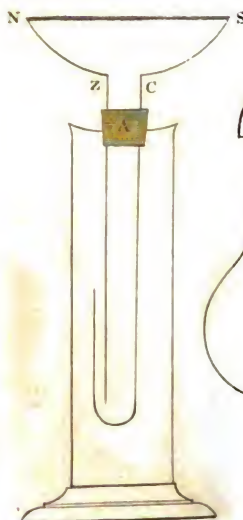
Fig 4.



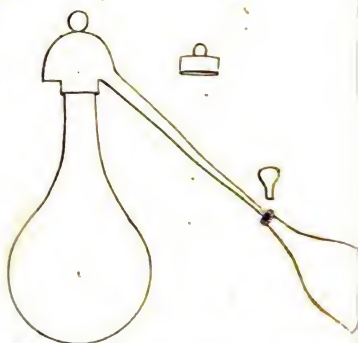
Fig 2.



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P. J. Janin's Galvano-Magnetic Instrument
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Silver Apparatus for Fluoric Acid. pa. 334

Fig. 16

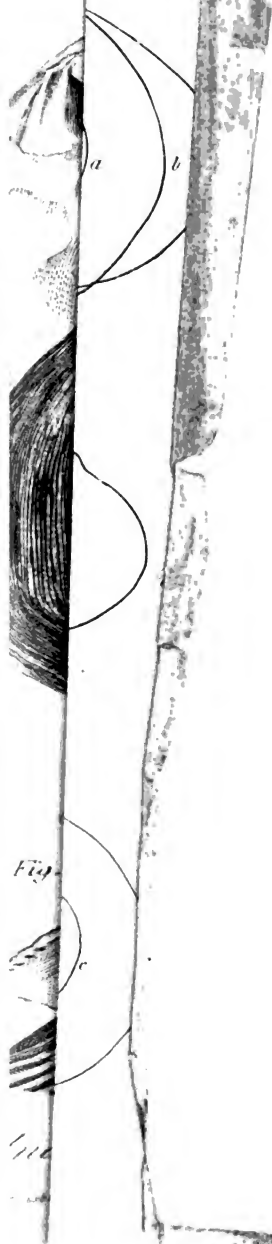
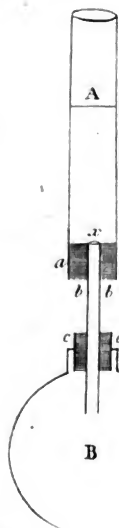


Fig.



Fig 1.



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